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ANALYTICAL ESSAYS

TOWARDS PROMOTING

THE

CHEMICAL KNOWLEDGE

OF

MINERAL SUBSTANCES.

Vol. I

BY MARTIN HENRY KLAPROTH,

PROFESSOR OF CHEMISTRY, ASSESSOR TO THE ROYAL COLLEGE OF PHYSICIANS, MEMBER OF THE ROYAL ACADEMY OF SCIENCES AT BERLIN, AND VARIOUS OTHER LEARNED SOCIETIES.

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THE merits of KLAPROTH, in Chemical Analyſis, are ſo eminently eſtabliſhed with men of ſcience throughout Europe, that it would ſeem improper to enlarge on the moſt conſummate ſkill and accuracy with which he performed his experiments, as well as on his laudable candour in ſtating their reſults.

On this conſideration, it is hoped that the tranſlation of his Analytico-chemical Eſſays, *&c. which is here offered to the patronage of the Engliſh Chemiſts, will meet with their kind approbation.—It may be neceſſary to add, that all the* Eſſays *of the Author relating to this ſubject, and which, in the German original, were publiſhed in two volumes, are, for the accommodation of the public, comprized in this ſingle Volume.*

Whenever Mr. Klaproth, *as he has given hopes to the Tranſlator, ſhall give another collection of his laſt and neweſt Eſſays, they will be immediately rendered into Engliſh.*

☞ *If ſome typographical errors, and a few other miſtakes which unfortunately have eſcaped the moſt careful attention, ſhould create ſome difficulty in the ſenſe, the reader is requeſted to refer to the errata in the laſt page.*

PREFACE

OF

THE AUTHOR.

IT has long been my deſign to collect my *Mineralogico-chemical Eſſays,* diſperſed in various books and journals, and to publiſh them, together with ſome new Reſearches; but want of time, and other impediments, have hitherto prevented me from accompliſhing it.

Much as I wiſhed to give to my Analytical Inquiries the greateſt poſſible degree of truth and perfection, and thereby to fulfil the duties which the Chemiſt owes to the Science which he intends to promote by his writings, as well as to the Public, to whom he offers the fruits of his labour; I was, nevertheleſs, too often under the neceſſity of experiencing, how difficult it is to accompliſh this purpoſe.

Of the 26 Treatiſes contained in this *firſt Vol. of Eſſays towards a Chemical Knowledge of Mineral Subſtances**, the greater number is here publiſhed proved by comparing my former with my later analytical experiments, made with the *Adamantine Spar*, and *Circon* (Jargon of Ceylon), which, on this account, I have placed next to each other in the reſpective Treatiſes. Who, for example, would have imagined, that the application of cauſtic alkali in the *liquid* ſtate ſhould ſo exceedingly facilitate the opening of hard ſtony matter, and remove the greateſt part of the difficulties with which I had to ſtruggle, when employing the ſame ſeparating medium in the *dry* ſtate?

---

* Mr. *Klaproth* here alludes to the publication of the firſt part of his Eſſays, at Berlin, 1795. The preſent volume comprehends alſo the ſecond part of them; and what is ſaid by the author, with reſpect to this laſt, has been added at the end of this Preface.—Tranſl.

As many perſons think that the preparation of a perfectly pure cauſtic lye is ſubject to more difficulties than it really is, I will here briefly ſtate my method of preparing it.—I boil equal parts of purified ſalt of tartar, (carbonat of potaſh, or vegetable alkali prepared from tartar) and Carrara marble, burnt to lime, with a ſufficient quantity of water, in a poliſhed iron kettle; I ſtrain the lye through clean linen, and, though yet turbid, reduce it by boiling, till it contain about one half of its weight of cauſtic alkali; after which I paſs it once more through a linen-cloth, and ſet it by in a glaſs bottle. After ſome days, when the lye has become clear of itſelf, by ſtanding, I carefully pour it off from the ſediment into another bottle. To convince myſelf of its purity, I ſaturate part of it with muriatic or nitric acid, evaporate it to dryneſs, and re-diſſolve it in water.

If it be pure, no turbidneſs will take place in the ſolution. The quantity of cauſtic alkali, which this lye contains, I aſcertain by evaporating a certain weighed portion of the lye to dryneſs, in an evaporating diſh of a known weight. I alſo take care, in the preparation of this cauſtic lye, that the alkali be not entirely deprived of carbonic acid; becauſe, in that caſe, I can, with greater certainty, depend on the total abſence of diſſolved calcareous earth. By employing burnt marble, or, in its ſtead, burnt oyſter-ſhells, I avoid the uſual contamination of the cauſtic lye by aluminous earth; becauſe lime, prepared from the common ſpecies of lime-ſtone, is ſeldom entirely free from argil.

Beſides, the choice of the veſſels requires great care. Since even the beſt porcelain is attacked and diſſolved by cauſtic alkali, I employ ſilver, reduced from muriat of ſilver, (Horn-ſilver), for veſſels appropriated to fuſion. This material, however, notwithſtanding its other advantages, is not abſolutely free from all inconvenience. For, if the crucible made of its has not been prepared with every poſſible care, ſmall ſcales will detach from it, which mingle with the body to be examined, and frequently occaſion illuſive appearances. Having already found, unexpectedly, that even a crucible made of platina would not, as had been wiſhed, reſiſt the action of ignited cauſtic alkali; I imagine that a crucible made of pure maſſive gold would be the moſt eligible. On this account, Profeſſor *Storr* ſeems to be in the right, when he concludes his *Propoſals, reſpecting the examination of the mixture of gems*[*], with the following words: "The difficulties occurring in this operation will the ſooner diſappear, if a great amateur of gems ſhould chooſe to ſpend the value of ſome thouſand ducats for their examination." Meanwhile, I flatter myſelf with having in ſome manner counteracted thoſe difficulties; though I was not encouraged by ſuch a high premium.

Though for the moſt part I have followed the *new nomenclature*, I have not ſcrupulouſly confined myſelf to its terms; but have, for the ſake of brevity, now and then uſed the denominations, *Glauber's-ſalt*, *Common-ſalt*, *Horn-ſilver*, *Blood-lye*, &c. as alſo the term *mild*, in ſtead of carbonated, in oppoſition to *cauſtic*[†]. Speaking of water, to avoid too frequent repetitions, I have moſtly omitted to particularize it as *diſtilled.* Thus, alſo, I have not in every ſingle inſtance mentioned the *edulcoration* of the precipitates, or reſidues; this and ſimilar operations being always underſtood to have been performed.

---

[*] *Crell's* Chemisches Journal, vol. VI. 1781. page 227.

[†] The Tranſlator, however, has, for the moſt part, preferred the *new nomenclature*, and frequently added the former denominations, for reaſons not neceſſary to be particularly mentioned.—Tranſl.

Concerning the Second Part.[*]

I HERE offer to the chemical and mineralogical public the *ſecond* volume of my *Eſſays*, &c. animated by the hope, that it will meet the ſame encouraging approbation with which the *firſt* has been honoured by ſcientific men, whoſe deciſion in this branch of the Knowledge of Nature commands reſpect.

The numbers of the Eſſays, contained in this volume, proceed in a continued ſeries with thoſe of the preceding. Of thoſe now given (1797), only a few have been before printed in various publications, and are here merely collected.—All the others are entirely new, and, at preſent, publiſhed for the firſt time.

As theſe eſſays were the fruit of my leiſure hours only, ſeveral of them have not arrived at that degree of perfection, to which, perhaps, they might have approached, if the uſual avocations of my duties had permitted me to perform them with greater convenience and opportunity.

---

[*] This is the Preface to Mr. *Klaproth's* ſecond volume of the German Edition; and the words, PART I. and PART II. have been deſignedly inſerted in the following Table of CONTENTS; the better to diſtinguiſh the firſt 26 Eſſays belonging to the firſt volume from the remaining eſſays, publiſhed in the ſecond volume of the original.

In this reſpect I earneſtly wiſh, that, for the advancement of the ſcience, the *chemico-analytical reſearches* publiſhed in this ſecond volume may ſhare the ſame good fortune with thoſe of the firſt: —I mean to ſay, that they may be examined, corrected, and farther purſued by expert Chemiſts.

M. H. KLAPROTH.

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I.

EXPERIMENTS

ON THE

HABITUDES OF VARIOUS SPECIES

OF

STONES AND EARTHS

IN THE

FIRE OF A PORCELAIN-FURNACE.

A SCIENTIFIC enquiry into that claſs of natural bodies, which belong to the *mineral kingdom*, includes a number of particulars, which it is neceſſary to unite, in order to obtain a complete knowledge of the ſubject.

Theſe are:

1. Their *geognoſtic* ſituation[*]: and
2. Their *external characteriſtic marks*: which both together conſtitute their *natural hiſtory*.
3. The experiments relating to the *phyſical properties* and powers of bodies in an undecompoſed ſtate. Such are: their ſpecific gravity, elaſticity, magnetic attraction, the phenomena exhibited by them with regard to light, and the like.
4. Their habitudes or changes in the *fire*; and
5. Their *chemical conſtituent parts*.

---

[*] *Werner*, who introduced the expreſſion *Geognoſy*, underſtands by it a general acquaintance with the ſolid parts of our globe, the various ſituations or beds of foſſils, and their reciprocal relations to each other. Thus he diſtinguiſhes geognoſy from *mineralogical geography*, which only treats of the native places of foſſils.—Tranſl.

As to the *habitudes of minerals in fire*, they indeed belong to the *chemical* part of natural ſcience; but ſo far only, as their conſtituent parts, or their proportions to each other, are made to ſuffer an alteration by this agent. Therefore, the phenomena, which take place on warming or heating, without producing a laſting change in the chemical mixture of the conſtituent parts, do not belong to this, but to its *phyſical* part. Thus, for inſtance, the power of attracting and repelling light bodies, excited in *Tourmaline* by warming it, ſhould only be reckoned among its phyſical properties; but, on the contrary, the phoſphoreſcence of the *Fluor-ſpar* and the *Apatite*, though but moderately heated, already effect ſome alteration in the natural chemical proportion of their conſtituent parts.

Though ſeveral induſtrious naturaliſts have examined various ſpecies of earths and ſtones merely by fire, few of them, however, have furniſhed *ſimple facts* or *experiments*. Some, as *Pott* and *Gellert*, according to their particular purpoſes, have directed their attention more to the products of fuſion, in compoſitions of their own making, than to the mere habitudes of the ſimple foſſils. Others, *D'Arcet* for inſtance, have indeed had regard to this laſt circumſtance; but they have miſſed their end, at leaſt for the greateſt part, by expoſing the body under trial to fire in immediate contact with argillaceous crucibles. For, the reſults could not fail to be falſe in moſt caſes, on account of the aluminous earth from the corroded maſs of the crucible mingling with the ſubſtance of the experiment.

So far as I know, Mr. *Gerhard** is the only chemiſt, who, in his valuable experiments concerning the habitudes of foſſils in the fire, has paid due attention to the nature of the veſſels; and has communicated true reſults, becauſe in his operations he employed crucibles of charcoal, beſides thoſe manufactured of clay and chalk.

---

* *Gerhard's Verſuch einer Geſchichte des Mineralreichs*, 2 Vol. Berlin, 1781-82.—Vol. II. § 2. page 1—44.

The reſults of my experiments on the effects produced by fire on various ſpecies of ſtones and earths, which I am now about to give, may ſerve to confirm ſeveral, and in ſome reſpects be conſidered as a continuation of thoſe of *Gerhard*.

When ſpeaking of the experiments on fuſion made by the above mentioned naturaliſts, as well as of my own, the mere action of *common* fire in wind and porcelain-furnaces is underſtood. Hence, neither dioptrical and catoptrical experiments belong to this inveſtigation; nor thoſe, which ſeveral philoſophers have made by ſtrengthening the fire by means of oxygen gas. For, howſoever valuable the latter are in other reſpects, I am inclined to think, that in a mineralogical view, the action of violent ignition ſuſtained by oxygen gas is not a convenient method for aſcertaining the relative habitudes of minerals in the fire.

To be enabled to draw juſt concluſions from experiments of this kind, it is neceſſary that they be all performed with the moſt equal degree of heat. This advantage was afforded to me by the furnaces of the Royal Porcelain-manufactory (at Berlin); into which the foſſils, ready prepared for this trial, were put; together with the porcelain, ſubjected to final baking.

For experiments to be performed in charcoal crucibles, a cavity was made in a thick fragment of well-burned charcoal, of a volume anſwering the ſize of the foſſil. This being put in, the cavity was cloſed with a charcoal ſtopper;

after

after which the charcoal-crucible was fitted into another crucible made of baked clay, and this laſt well joined with its cover by luting.

In order to make comparative experiments, I placed another quantity of each foſſil immediately in a crucible made of clay unmixed with iron. After the cover had been luted on, it was expoſed to the ſame intenſity of heat.

In every caſe where the loſs of weight could be aſcertained with ſome degree of certainty, I have always mentioned it.

No. I. ADULARIA; from Mount St. *Gotthard.*

a) In the *charcoal-crucible**, a colourleſs glaſs, clear in its ſubſtance, but quite full of very ſmall froth-bubbles. On this account it appears of a greyiſh-white, and exhibits no vitreous ſplintery fracture, but a minute conchoidal, with very fine pores.

b) In the *clay-crucible.* The ſame.

No. 2. White ALABASTER.

a) CH. Cr. was rendered moderately hard, white paſſing into ſtraw-yellow, in ſome places finely ſtreaked, of a fine-grained earthy fracture, adhering to the tongue, and emitting an odour like that of alkaline ſulphuret.—Loſs of weight, 0,56.

---

* For the ſake of brevity, the *Charcoal-crucible* is marked CH. Cr. and the *Clay-crucible*, CL. Cr.

In the ſame manner L. of W. means *loſs of weight.*

b) CL. Cr. A black-brown glaſs, very ſhining, little tranſparent on the edges, with ſeparate bubbles.

No. 3. AMIANTHUS; from *Greenland.*

a) CH. Cr. A roundiſh fuſed ſcoria, of a dirty pearl grey, externally covered with ſome ſmall grains of iron. Fracture, dull, finely porous, with diſperſed inlaid gloſſy particles.

b) CL. Cr. Has run into a greeniſh, opake ſcoria, of a fracture almoſt dull. The whole ſurface covered with cryſtals of a greeniſh and light brown colour, in the form of delicate needles, of a reticular form.

No. 4. ASBESTUS, mountain green: (Berg-holz) from *Siberia.*

a) CH. Cr. Unaltered as to form, ſimply hardened by ignition. Its ſurface inveſted with a thin reddiſh cruſt; the edges blackiſh, and overlaid with fine exſuded grains of iron.—L. of W. 0,16.

b) CL. Cr. The form likewiſe unchanged; of a light-brown colour, rendered very hard, and covered with ſome ferruginous ſpots.

No. 5. ASBESTUS; from *Taberg.*

a) CH. Cr. A light-grey ſlag, fuſed into a ſphere, and covered with grains of iron, of a glittering ſurface, and having detached, ſhining, large bubble-holes.—L. of W. 0,25.

N. 6. BASALT; aſh-grey, coarſe-grained. (Swed. *Trap*; and, according to *Werner*, Grünſtein;) from *Hunneberg*, in Weſtgothland.

a) CH. Cr. Fuſed into a compact glaſs, of a clove-brown colour, *tranſparent in ſplinters*, of a large conchoidal fracture. Externally, partly glazed brown, partly inveſted with a ferruginous cruſt, and large grains of iron. —L. of W. 0,06.

b) A ſolid black glaſs, covered with a brown, ſteel-grey, veined iron-cruſt.

No. 7. BASALT, denſe, columnar; from the *Haſenberge*, in the middle mountains of Bohemia.

a) CH. Cr. Externally, a compact grey maſs, richly over-laid with pretty large grains of iron, and in part alſo covered with a tombac-brown ferruginous cruſt. Its fracture of a bright aſh-grey, and to appearance dull and earthy; but if examined with a lens, poſſeſſed of a texture very finely porous, and ſpongy throughout; and very rough to the feel.—L. of W. 0,09.

b) CL. Cr. A black denſe glaſs, tranſparent, and of a clove-brown, in thin ſplinters, of an even or groſs-conchoidal fracture. At the top, it exhibits a light-brown, gloſſy, and delicately-flowered cruſt.

No. 8. BASALT, denſe, columnar; from *Stolpe*, in Saxony.

a) CH. Cr. A compact maſs, inveſted at the top with a blackiſh grey glazing, but, on the ſides and underneath, with numerous grains of iron, and in part covered with a tombac-brown iron-cruſt. In fracture, aſh-grey, dull, denſe, ſomewhat ſplintery, in ſome places of a ſpongy texture hardly diſtinguiſhable, and in others exhibiting clove-brown gloſſy veins.—L. of W. 0,08.

Note 1. Another, but ſmaller quantity of the ſame baſalt, treated in the ſame manner, I found, had the ſame external appearances: but its internal colour was white-grey; its texture was more denſe, and traverſed by minute, blackiſh vitreous veins.

Note 2. I put the ſpecimen of No. 8. *a*) a ſecond time into the charcoal crucible, after having ſeparated the iron-grains. It appeared afterwards of an amorphous, and on the upper part confuſedly fibrous form; but its fracture preſented a darkiſh grey, compact, fine-grained, untranſparent, highly glittering, and, towards the ſides, greaſy gloſſy ſcoria.

b) CL. Cr. As No. 7. *b*).

No. 9. BASALT, largely perforated, with interſperſed, ſingle, ſmall grains of olivin; from the iſland of *Skye*.

a) CH. Cr. On the ſurface overlaid with many grains of iron, of a conſiderable ſize. Fracture dark aſh-grey, very rugged, dull, and earthy; but, viewed by a lens, ſpongy, with fine pores.—L. of W. 0,08.

Note. The grains of iron being ſeparated, this maſs was again placed in a freſh CH. Cr. Its ſurface then aſſumed the figure of vermicularly twiſted branches, lying flat; ſome of which had a copper-red metallic luſtre. Its fracture like No. 8, note 2.

b) CL. Cr. The ſame as No. 7. *b)*

No. 10. BASALT, porphyraceous; from the new *Cammeni*, near *Santorini*.

Note. The principal black maſs was a medium between ſiliceous ſhiſtus, *(Kieſelſchieſer)* jaſper, and baſalt; with diſſeminated tender, white, vitreous ſquares and grains.

a) CH. Cr. Melted into a ſolid, blackiſh glaſs; whoſe fragments were of a yellowiſh-green, and tranſparent. It was covered with a ſteel-grey ferruginous cruſt, and of a gloſſy, large conchoidal fracture.—L. of W. 0,02.

b) CL. Cr. A compact, black glaſs; but its ſplinters clove-brown and tranſparent. Fracture of the large, and, in ſome degree, ſmooth conchoidal form. Surface inveſted with a bright brown, ſhining pellicle.

No. 11. LIGNIFORM ASBESTUS (Bergholz), brown; from *Tyrol.*

a) CH. Cr. Suffered no alteration of form; burned hard, and aſſumed a greeniſh-brown ſurface, with a red and white inveſtment. Its edges foliated in lamellæ, blackiſh, and garniſhed with extremely delicate exſuded grains of iron. Fracture bright, ſteel-grey, and glittering.—L. of W. 0,39.

b) CL. Cr. Coaleſcing by fuſion with the parts of the crucibles that were in contact with the fragments. Their external ſurfaces exhibited a texture, conſiſting of brown, reſplendent, implicated, ſhort ſtriæ. The fracture dark-grey, little ſhining, and of bright-grey rays and points, as it were interwoven, with ſome air-bubbles.

No. 12. BERYL, yellow; from *Siberia.*

a) CH. Cr. No change in the figure. Colour dirty pale-bluiſh-grey, with a greaſy luſtre, and a little tranſparent. Fracture uneven, groſs-ſplintery.—L. of W. 0,01.

b) CL. Cr. The ſame.

No. 13. BERYL, ſea-green; alſo from *Siberia.*

a) CH. Cr. In general of leſs ſplendour; but the lateral ſurfaces of the column covered all over with fine, ſhining, needle-formed radii. In other reſpects, as No. 12. *a*)

b) CL. Cr. Like No. 12. *b*)

No. 14. SHORLITE (*Schörlartiger Beryl*); from *Altenberg.*

a) CH. Cr. Unaltered as to form; indurated by the ignition; became grey, dull, and rough; with minute glittering points of a nearly metallic luſtre.—L. of W. 0,25.

b) CL. Cr. The ſame phenomena; but without ſhining points.

No. 15. PUMICE-STONE, common; from *Lipari.*

a) CH. Cr. A bluiſh-black-grey, denſe glaſs, with ſome air-bubbles; ſemi-tranſlucid when reduced to thin fragments; and externally overlaid with a few grains of iron. L. of W. 0,10.

b) CL. Cr. Afforded a clearly fuſed, light-blackiſh-green, glaſſy ſubſtance, of almoſt colourleſs and clear ſplinters, with ſome air-bubbles.

No. 16. COMPOUND SPAR (*Bitterſpath*); from *Zillerthal*, in *Tyrol.*

a) CH. Cr. Fell into ſmall yellowiſh-grey, and yellowiſh-brown, friable, and in part diſtinctly rhomboidal pieces, of an earthy appearance.—L. of W. 0,45.

b) CL. Cr. On the upper part it run into a clear, bright graſs-green glaſs, of a ſmooth ſurface; but on the lower part into a light-grey frothy ſcoria.

No. 17. BOLE, red armenian; *genuine.*

Note. Conſiſts of a red, friable lithomarga *(Steinmark)*, with white ſpeckles.

a) CH. Cr. Burned hard, was glittering, and of an iron-black colour.—L. of W. 0,20.

b) CL. Cr. Hardened by burning; partly ſteel-grey, partly dirty-brown; having the ſurface covered with tranſuded and re-calcined or oxyded ferruginous particles; rough and porous.

No. 18. BOLE, red armenian; *common.*

a) Melted into an ill-ſhaped hollow globe, whoſe outward and inward ſurfaces were of a dim ſteel-grey colour, and inlaid with reſplendent grains of iron. Its fracture preſented a black-grey ſlag, ſhining, and in part porous.— L. of W. 0,16.

b) CL. Cr. Gave a brown ſcoria; gloſſy like pitch; full of large bubbles; of an uneven ſurface, reſembling the ſpecular or grey iron-ore (*eiſen-glänziz*).

No. 19. BORACITE; from *Lüneburg*.

a) CH. Cr. Each cryſtal fell ſeparately into a globular form; acquired a cavity in the middle, and preſented here and there incumbent, very tender ferruginous grains. Fracture whitiſh-grey, ſhining, uneven, and foliated; in part alſo ſtriated.

b) CL. Cr. Produced a yellowiſh, clear glaſs, containing ſome air-bubbles; and having ſeparate, ſmall, dim-white ſpots.

No. 20. SIDERO-CALCITE (*Braunſpath*), in lumps*, grey-white; from *Freyberg*.

a) CH. Cr. Fell into black-brown, cracked and friable lumps, entirely reſembling perfectly decayed ſiderocalcite, and ſhewed exceedingly minute, tranſuded metallic grains.

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* In German *derbe*, the preciſe meaning of which expreſſion *Kirwan* aſſerts, (Elem. of Mineral. I. p 26) he could never learn. According to *Emmerling*, any ſolid foſſil is called *derbe* which is concreted or imbedded in another, and is of the ſize of a *hazel-nut*, and above, to any magnitude; whereas that which is called in German *eingeſprengt* (diſſeminated, interſperſed) is under the ſize of a hazel-nut, to any minuteneſs obſervable. As the ſize of the foſſils treated of in this work is ſeldom determined, the word *derbe* will be given in this tranſlation by the expreſſions *in lumps*, *in maſſes*, and ſometimes *maſſive*.—Tranſl.

b) CL. Cr. Changed into a glaſs of a dark black-brown colour, tranſparent on the edges, and pellucid in ſmall fragments.

No. 21. CORNELIAN, oriental.

a) CH. Cr. No change in its form, very fragile, of a ſnowy-white from the outer edge, almoſt to the thickneſs of $\frac{1}{12}$ inch; but internally very pale reddiſh white. The fracture of the white border was conchoidal and reſplendent; that of the inner parts earthy and dull.—It ſuffered no loſs of weight.

b) CL. Cr. Throughout of a ſnow-white, partly ſpotted, ſomewhat greyiſh, and preſerving its external ſplendour.

No. 22. CHALCEDONY; from *Ferröe.*

a) CH. Cr. Of unaltered ſhape; white as ſnow; eaſy to be broken; externally, and in the fracture, glittering.—L. of W. 0,01.

b) CL. Cr. The ſame.

No. 23. CHLORITE, looſe, from the cavity of a rock-cryſtal; from *St. Gotthard.*

a) CH. Cr. A contracted, black, ſhining, ſomewhat radiated maſs, ſimilar to a brittle pit-coal.

b) CL. Cr. Fuſed into a ſolid, black-brown, vitreous ſubſtance.

No. 24. CHRYSOBERYL, from *Braſil.*

a) CH. Cr. Remained totally unchanged, except that its ſurface became a little rougher.

b) CL. Cr. Likewiſe unaltered; only its colour turned ſomewhat paler, and the external ſurface acquired ſpots of a dull white.

No. 25. CHRYSOLITE, oriental.

a) CH. Cr. Its ſurface covered with a thick ferruginous cruſt, of a reddiſh-brown, paſſing into ſteel-grey, and glittering. Its original green colour was no longer perceivable in the fracture. Its form, ſplendour, and tranſparency, quite unaltered.

b) CL. Cr. No change as to form, tranſparency, and luſtre; but the colour inclined now to olive-green.

No. 26. CHRYSOPRASE; from *Koſemütz.*

a) CH. Cr. Had its figure unaltered; turned very light blackiſh-grey, of a ſtrong gloſs, and perfectly opake. In the ſtreak it exhibited a kind of metallic luſtre.—L. of W. 0,01.

b) CL. Cr. The ſame effect.

No. 27. CIMOLITE; from the iſland of *Cimolo* (Cimolia Plinii).

a) CH. Cr. A black-grey, moderately ſhining, ſcummy ſlag, of little weight.—L. of W. 0,25.

b) CL. Cr. A yellowiſh-white, half fuſed, hard, ſmall frothy ſcoria, reſembling corroded quarz.

No. 28. CYANITE, cryſtallized; from *St. Gotthard.*

a) CH. Cr. Burned white, was ſplit, became very friable, and internally ſhining.—No loſs of weight.

b) CL. Cr. The ſame.

No. 29. CYANITE, common; from the ſame place.

a) CH. Cr. Was rendered aſh-grey by ignition, and ſplit, in the manner of wood.—No loſs of weight.

b) CL. Cr. Snowy-white, and ſplit.

No. 30. FEL-SPAR? compact, blue; from *Kriegluch.*

a) CH. Cr. Furniſhed a grey-white glaſs, ſcummy in the fracture, and thereby divided into ſhapeleſs cellules, like fine tabular quarz. It preſented detached ferruginous grains, and ſhewed alſo on the ſurface a number of fine ſplendid ſpeckles.—L. of W. 0,40.

b) CL. Cr. Shrunk into milky-white, irregular, rough lumps, with a diſtinctly beginning vitrification.

No. 31. FEL-SPAR, common, red; from *Lomnitz.*

a) CH. Cr. As No. 1. *a*)
b) CL. Cr. As No. 1. *a*)

No. 32. FEL-SPAR, vitreous, in hexagonal plates; from the *Porphyry* of *Drachenfels.*

a) CH. Cr. A greyiſh-white glaſs, almoſt pellucid; of a ſtrong gloſs on the fracture, and having air-bubbles.—L. of W. 0,02.

b) CL. Cr. A ſemi-pellucid, bright-grey, ſomewhat frothed glaſs; in ſome places ſpeckled blackiſh or browniſh.

No. 33. FEL-SPAR, green; from *Siberia.*

a) CH. Cr. Like No. 32. *a*)

b) CL. Cr. Produced a milk-white glaſs, of a fine froth, but clear in ſmall pieces.

No. 34. FLUOR-SPAR, yellow, cubic; from *Gerſdorf.*

a) CH. Cr. A milky-white ſcoria; fuſed on the outſide; in the fracture lamellar, of reſplendent planes.—L. of W. 0,04.

b) CL. Cr. Fuſed into a clear, bright graſs-green glaſs.

No.

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No. 35. SPECULAR GYPSUM (*Fraueneis, glacies Mariæ.*)

a) CH. Cr. Rendered white, very friable; and its lamellæ ſpecular or reflecting light.—L. of W. 0,60.

b) CL. Cr. Clove-brown glaſs, with large ſpherical air-bubbles.

No. 36. HYALITE, or Glaſs-ſtone, (VIOLET SHOERL); cryſtallized; from *Dauphiny*.

a) CH. Cr. A ſemi-pellucid greyiſh-white glaſs, brilliant, flat conchoidal fracture; outwardly ſpread over with ferruginous grains.—L. of W. 0,12.

b) CL. Cr. A denſe, ſemi-pellucid, deep clove-brown.

No. 37. HYALITE (*Violet Shörl*), in maſſes; from *Thum* (*Thumerſtone*).

a) CH. Cr. As No. 36. *a*).—L. of W. 0,10.
b) CL. Cr. As No. 36. *b*).

No. 38. MICA, grey, groſs-foliated; from *Cornwall*.

a) CH. Cr. A greeniſh-grey, ſemi-pellucid glaſs, overlaid with minute grains of iron.—L. of W. 0,10.

b) CL. Cr. Run into a compact, blackiſh, opake glaſs; of a ſmooth, ſtrongly-ſhining ſurface, and conchoidal fracture.

No. 39. GARNET, red, bohemian.

a) CH. Cr. Afforded a grey, turbid glaſs; full of grains of iron.

b) CL. Cr. Fuſed into an opake, almoſt compact ſcoria, whoſe colour internally changed by ſtripes from brown into green; very finely corroded.

No. 40. GARNET, oriental.

a) CH. Cr. The ſame change as No. 39: *a*).

b) CL. Cr. Yielded a compact black glaſs; of a bright luſtre; covered with a ſteel-grey cruſt.

No. 41. GRANATITE, (till now ſo called); from St. *Gotthard.*

a) CH. Cr. Became hard; ſteel-grey; overlaid with ſmall ferruginous grains.

b) CL. Cr. Rendered hard; of an iron black colour; with ſhining points of a metallic luſtre.

No. 42, GREEN EARTH; from *Cyprus*.

a) CH. Cr. Fuſed into an irregular ſphere; which had externally a dirty green colour, and preſented in the fracture a ſomewhat porous maſs, compoſed of an emerald-green glaſs and a pale-green ſcoria. Here and there it was croſſed partly by white metallic lamellæ, partly by reguline copper. There was alſo found, in one of its cavities, a variegated copper-ore in ſmall grains.—L. of W. 0,17.

b) CL. Cr. Exhibited a fuſed compact ſcoria; in the fracture of which the upper part was brown and reſplendent; the lower one greeniſh grey, and glittering. At top it ſhewed grey-white, delicate plumoſe traces, of a luſtre nearly metallic, upon a brown ground.

No. 43. HELIOTROPIUM, oriental.

a) The figure unaltered; but rendered a little ſofter by the ignition. The colour changed from dull-greeniſh to a grey-white. Its fracture uneven, ſplintery, rough and glittering. The red points, which had diſappeared, left ſmall holes behind them.—L. of W. 0,01.

b) CL. Cr. The colour turned throughout whitiſh grey. In other reſpects as at *a*).

No. 44. HORN-BLENDE, baſaltic; from the crater of *Veſuvius*.

a) CH. Cr. A hardened, ill-ſhaped maſs, with grains of iron. Fracture light-grey, uneven, faintly glittering; without any trace of vitrification.—L. of W. 0,10.

b) CL. Cr. Melted into a denſe, black-brown glaſs; tranſparent in thin fragments; of a ſmooth ſurface, and a flat conchoidal, gloſſy fracture.

No. 45. HORN BLENDE, common; from *Neurode*, in the county of *Glatz*, in Bohemia.

a) CH. Cr. An indurated maſs; on the outſide wrinkled, of a colour verging into copper-red, inlaid with many granular particles of iron. Internally light pearly-grey, uneven, ſlightly glittering; here and there with a beginning vitrification.—L. of W. 0,06.

b) CL. Cr. As No. 44. *b*).

No. 46. HORNBLENDE? common; from *Nora*, in Weſtmanland.

a) CH. Cr. Run into an imperfect, greeniſh-black vitreous ſubſtance, tranſparent on the edges, overlaid with an iron black, rugoſe or ſhrivelled cruſt. Fracture, with air-bubbles, of a copper-colour.—L. of W. 0,14.

b) CL. Cr. A compact ſcoria, whoſe colour, from below upwards, changed from leek-green to greeniſh black. Covered with a ſteel-grey metallic cruſt. Fracture, moderately ſhining, of a greaſy luſtre.

No.

No. 47. HYACINTH; from *Ceylon.*

a) CH. Cr. Its colour became greyiſh-white. The cryſtals in ſome degree coaleſced; but remained in other reſpects unchanged, except their tranſparency being diminiſhed..—No. L. of W.

b) CL. Cr. Such of the cryſtals as were in contact with the crucible, united with it by fuſion, throwing up a ferruginous cruſt. The others were looſely conglutinated together. The colour, in part, paſſed into a wine-yellow.

No. 48. CAT'S-EYES, grey-white; from *Ceylon.*

a) CH. Cr. Became ſoft, grey, dimmed, and opake by the action of the fire.—No. L. of W.

b) CL. Cr. The ſame change.

No. 49. CAT'S-EYE, red; from *Malabar.*

a) CH. Cr. Like No. 48. *a*)

b) CL. Cr. The ſame.

No. 50. LABRADOR-HORNBLENDE (*Labrador-ſtein).*

a) CH. Cr. Fuſed into a compact glaſs, of great luſtre, pellucid in ſmall ſplinters, of a pale-grey colour, with very minute, detached grains of iron.—L. of W. 0,04.

b) CL. Cr. A compact, duſky-white ſcoria, tranſparent on the edges.

b) CL. Cr. The ſame changes; together with a ſomewhat brighter luſtre.

No. 67. OPAL, *ſemi-opal of a verdigris-colour (Heliotropium?)*; from Greenland.

a) CH. Cr. Was rendered ſoft, its fracture of a light-reddiſh-brown, ſpeckled with a copper-red; glittering, and exhibiting dim-white points and veins.

b) CL. Cr. Rendered not quite ſo ſoft by the ignition; and it acquired a liver-colour, with white ſpots.—L. of W. 0,06.

No. 68. PITCH-STONE, yellow; from *Meiſſen.*

a) CH. Cr. A greyiſh-white glaſs; though clear in itſelf, yet full of froth-bubbles. The outer ſurface preſented a deep-grey, ſhining cruſt.

b) CL. Cr. The ſame; but without the external incruſtation.

No. 69. PITCH-STONE, blue (ſo ſtyled); from *Menil-Montant*, near Paris.

a) CH. Cr. Became ſoft, yellowiſh-white, and ſplit or cleft in the manner of ſlate.

b) CL. Cr. The ſame changes; except its colour turning light-brown.—L. of W. 0,08.

No. 70. SHISTOSE PORPHYRY; from *Schlosſberg* near *Toplitz.* (Its chief maſs the *Klingſtein*, as it is called).

a) CH. Cr. Run into a denſe, very ſhining glaſs, of a grey tinge inclining to deep-green; tranſparent in ſmall fragments, and inlaid with detached, nearly tin-white grains of iron.—L. of W 0,05.

b) CL. Cr. A compact browniſh-black glaſs, with tranſparent edges, and a conchoidal fracture.

No. 71. PORCELAIN JASPER, yellow; from Bohemia.

a) CH. Cr. Suffered no alteration in its form; but was rendered ſomewhat contracted, of a deep ſteel-grey, and dull.

b) CL. Cr. Figure unchanged; externally yellowiſh-brown; in the fracture, black and glittering.

No. 72. PRASE; from *Breitenbrunn.*

a) CH. Cr. Its form unaltered; externally of a grey-white, ſhining, inlaid with tranſuded grains of iron. Its fracture, greeniſh-white, of a faint luſtre, and uneven. Totally opake.—L. of W. 0,03.

b) CL. Cr. The form likewiſe unaltered; externally of a ſmutty-greeniſh white, gloſſy, and ſpotted with minute drops reſembling pitch. Fracture grey and dim.

No. 73. QUARZ, red; from *Rabenſtein.*

a) CH. Cr. No change in the figure; colour entirely pale reddiſh-white; ſlightly tranſparent; and inveſted with a delicate glazing.—L. of W. 0,03.

b) CL. Cr. The ſame.

No. 74. RUBY, roſe-red, *oriental.*

a) CH. Cr. No alteration; except its ſurface having become a little dimmed.—Alſo without L. of W.

b) CL. Cr. Entirely unchanged. Its colour even ſeemed to be rendered ſtill purer and more lively than before ignition.

No. 75. MUSCOVY GLASS (*Gliſt, Mica*); from *Siberia.*

a) CH. Cr. In order to incloſe it in the crucible, ſeveral lamellas were rolled up. The outer ones became grey, glazed and brittle; the inner ones black, like tinder, and continued flexible.—No. L. of W.

b) CL. Cr. Every one of the lamellas thoroughly hardened by the ignition, glazed, brittle, rendered nearly ſonorous. Colour changed to a greyiſh-white; the ſurface in part alſo light-brown.—No. L. of W.

No. 76. SAPPHIRE, azure-blue; from *Ceylon.*

a) CH. Cr. Without alteration; except the ſurface, which became a little duſky, and dim and muddy.—No loſs of weight.

b) CL. Cr. Likewiſe unaltered. However, the colour was rendered in ſome pieces paler, and at the ſame time ſlightly opaleſcent.

No. 77. PRISMATIC SHOERL, black, longitudinally ſtreaked; from *Cornwall.*

a) CH. Cr. Little change in the figure. Outwardly, ſtill preſerving, in part, the priſmatic form, with grains of iron exuded. Fracture grey, of but little gloſs, reſembling that of fat.—L. of W. 0,09.

b) CL. Cr. Imperfectly fuſed; on the upper part brown, with glittering points. Fracture of a blackiſh-grey, ſlightly reſplendent, with a greaſy luſtre, and exhibiting fine pores.

No. 78. SHOERL, black cryſtallized, in columns of nine ſides; from St. *Gotthard.*

a) CH. Cr. Externally aſh-grey, and very much ſhrivelled. In the fracture preſenting a compact, ſmoke-grey, moderately ſhining ſcoria; with ſeveral large bubbles, containing on the inſide diſſeminated granular particles of iron.—L. of W. 0,08.

b) CL. Cr. Fuſed into a tough, pale, olive-green ſlag, of a moderate gloſs like fat; with ſeveral large air-bubbles.

No. 79. SHOERL, black, in large hexagonal columns; from *Greenland.*

a) CH. C. Converted into a ſcoria of a greeniſh-grey tinge, and tranſparent fragments. Its ſurface was coated with a duſky cruſt, and ſcattered grains of iron.—L. of W. 0,07.

b) CL. Cr. An olive-green ſlag, tranſparent in thin ſplinters, of conſiderable compactneſs, and a wrinkled ſurface.

No. 80. SERPENTINE, blackiſh; from *Zöblitz.*

a) CH. Cr. Indurated; externally covered with a ferruginous cruſt, together with ſmall grains of iron. In the fracture, ſplintery, dull and of a grey colour.—L. of W. 0,12.

b) CL. Cr. Rendered hard. The ſurface glittering, glazed in part, and paſſing from iron-black to a copper-red. Towards the edges of the fracture likewiſe iron-black, but in the middle of a pale greeniſh-grey; ſmooth and dull.

No. 81. EMERALD; from *Peru*.

a) CH. Cr. Entered into an imperfect fuſion, and preſerved its green colour, though ſomewhat fouled. It alſo was rendered opake, and preſented detached minute grains of iron.

b) CL. Cr. A clear, greeniſh-white glaſs, with a few radiating points.

No. 82. EMERALD? oriental; (perhaps green ſapphire?)

a) CH. Cr. Quite unaltered in ſhape. The colour was rendered ſomewhat duller, and verging towards grey. The ſurface partially covered with a rough cruſt; ſome pieces reflected changeable variegated colours.

b) CL. Cr. Figure and luſtre as before. Turned opake. The green colour in part paſſed to a white, and in ſome pieces the variegated reflection of colours was ſtill more diſtinct.

No. 83. SPINELL (Ruby).

a) CH. Cr. Suffered no change, excepting that its ſurface became ſomewhat muddy and foul.—No loſs of weight

b) CL. Cr. Part of it was imperfectly melted to a blackiſh-brown ſcoria, into which were cemented the other pieces, whoſe colour and tranſparency were unimpaired.

No. 84. ACTYNOLITE (Strahlſtein) common, green; from St. *Gotthard.*

a) CH. Cr. Externally covered with a ferruginous cruſt, and numerous grains of iron. The inſide ſhewed a grey and dull ſcoria, full of bubbles.—L. of W. 0,04.

b) CL. Cr. Converted into a fibrous ſlag, of a greeniſh-grey fracture, and a brown ſurface, cryſtallized in a radiated form.

No. 85. ACTYNOLITE, common, leek-green; from *Peterſburg*. (Swed. *Hornblenda*).

a) CH. Cr. Like No. 84. *a*); only with but few grains of iron in the ſurface, and with acicular cryſtals in the froth bubbles.—L. of W. 0,04.

b) CL. Cr. A leek-green, and at the top red-brown, compact ſcoria; of a fine ſtriated fracture, and efflореſcent cryſtallization.

No. 86. ACTYNOLITE, common, in ſeparate parallel priſms; from *Carinthia.*

a) CH. Cr. A dull, bluiſh-grey ſcoria, full of bubbles and its ſurface inlaid with grains of iron.—L. of W. 0,04.

b) CL. Cr. A denſe, greeniſh-white, and in the fracture indiſtinctly radiated flag. On the upper ſurface cryſtallized in interwoven, reticular, fine, brown needles.

No. 87. GLASSY ACTYNOLITE; needle-ſhaped, of an intermediate colour between deep mountain-green, and black-green; from *Taberg.*

a) CH. Cr. As No. 86, *a*). Its cruſt had in ſome places a cupreous luſtre.—L. of W. 0.12.

b) CL. Cr. Fuſed into a denſe, greyiſh-white, opake ſcoria, marbled of a brown-yellow at its top.

No. 88. GLASSY ACTYNOLITE, acicular, white; from *Taberg.*

a) CH. Cr. A greyiſh-white maſs, fuſed in a ſpherical form; on the upper part with ſeparate, recumbent, ſhining radiations; on the under part mixed with grains of iron. Fracture uneven, dull and rough; in parts ſtriated.—L. of W. 0,20.

b) CL. Cr. A greeniſh-white, denſe ſcoria, with a glittering greeniſh-yellow very fine efflореſcent ſurface of ſmall ſtellular points. Fracture finely fibrous and reſplendent.

No. 89. ACTYNOLITE, olive-green, in priſmatic cryſtals; from *Dauphiné.*

a) CH. Cr. The pieces did not fuſe together, but were merely conglutinated firmly. External ſurface, iron-black, with ſmall ferruginous grains, oozed through. Inſide ſteel-grey, fine earthy, and dull.—L. of W. 0,15.

b) CL. Cr. Melted into a highly reſplendent glaſs; of a black-brown colour; flat conchoidal fracture, and tranſparent ſplinters.

No. 90. ACTYNOLITE, cryſtallized in priſms, deep blackiſh-green; from *Zillerthal* in Tyrol.

a) CH. Cr. Fuſed into a ſpherical, moderately ſplendid, opake ſcoria, of a bright greeniſh-grey colour, and perfectly radiated fracture, ſurrounded with grains of iron.—L. of W. 0,06.

b) CL. Cr. A ſtrongly reſplendent, compact, opake flag, internally almoſt apple-green; of a conchoidal fracture, and yellow ſurface, mixed with brown.

No. 91. STRONTIANITE.

a) CH. Cr. Form unaltered. Hardened by ignition; rendered dull, and very cauſtic.—L. of W. 0,31.

b) CL. Cr. A clear, bright graſs-green glaſs.

No. 92. TALC (of the *magneſian* or *muriatic* genus); greeniſh-white; from St. *Gotthard*.

a) CH. Cr. Became hard; ſplit like ſlate; grey white; in two places ſlightly united with the crucible by fuſion.

b) CL. Cr. Rendered yellowiſh-white; hardened by the ignition, and acquiring ſlaty rifts.—L. of W. 0,05.

No. 93. TALC, Venetian.

a) CH. Cr. Indurated, ſlaty, bluiſh-grey; in part with a thin red covering.—L. of W. 0,08.

[illegible] Rendered whit
a fine earthy and longitudinally
W. 0,20.

b) Cl., Cr. The ſame; with

No. 95. TOPAZ; fro

a) CH. Cr. As No. 94, a).—

b) Cl., Cr. As No. 94. b).—

No. 96. TREMOLITE, radia

a) CH. Cr. Ran into an op
[illegible], of a radiated texture, and
[illegible].—L. of W. 0,25.

b) Cl. Cr. A compact, green
of [illegible] of a radiated ſtructure.

No. 97. [illegible], from [illegible]
[illegible]

No. 98. TOURMALINE, green, tranſparent; from *Braſil.*

a) CH. Cr. Hardened by the ignition. The ſides compreſſed inwards. Externally black-brown; internally greeniſh-grey, opake and dull.—L. of W. 0,10.

b) CL. Cr. The ſame change; but of a blacker tinge. The part of the crucible, in contact with it, covered with a brown glaze.

No. 99. TOURMALINE, black; from *Spain.*

a) CH. Cr. Hardened, and the cryſtals conglutinated. Outſide black, with croſs rifts and dull; inſide dim grey-white. Fracture, conchoidal. Slight gloſs of the greaſy kind.—L. of W. 0,15.

b) CL. Cr. Externally the ſame. The fracture, of a ſteel-grey, but with rather leſs luſtre, and with fine pores.

No. 100. TOURMALINE, black; from *Zillerthal.*

a) CH. Cr. Aſſumed a very irregular ſhape. Externally like No. 99, *a*); inwardly, of a conchoidal fracture, a ſmoky grey colour, and greaſy luſtre.

b) CL. Cr. Tough; diffuſed by melting; light-brown, opake, and of a middling greaſy luſtre.

No. 101. UMBER, (brown iron-ochre); from the neighbourhood of *Cologne.*

a) CH. Cr. Gave a denſe, opaline glaſs; of a bluiſh-grey in the fracture, tranſparent when in ſmall ſplinters, and of a ſtrong greaſy luſtre. It was coated with a grey-white cruſt, finely dotted by very minute froth-bubbles. At the bottom was one conſiderable grain of iron, whic ſeparated of itſelf.—L. of W. 0,33.

b) CL. Cr. Fuſed into a ſolid, black glaſs; whoſ upper part was covered with a cruſt of the ſpecular iron-ore, (*Eiſenglanz*) very delicately efflореſcent, and radiated i a ſtellular form.

No. 102. UMBER; from *Cyprus*.

a) CH. Cr. Like No. 101, *a*) except that its cruſt wa ſtill more minutely dotted, and the inward colour of clear ſmoke-grey.—L. of W. 0,33.

b) CL. Cr. Like No. 101. *b*)

No. 103. VESUVIAN, light-brown.

a) CH. Cr. A denſe, clear, ſtrongly reſplendent, nearl colourleſs glaſs. The outer ſurface was rather muddy, an was formed into groups of regular cryſtals (*druſigt*) exhibiting very minute ſhort protuberances, each of whic ended in a point, by means of four triangular, exceedingl fine ſtriated facets. Numerous grains of iron were imbedded in its under ſurface.—L. of W. 0,25.

b. CL. Cr. A compact, very dark olive-green glaſs of a bright luſtre, and flat conchoidal fracture.

No. 104. VOLCANIC aſhes; (from the eruption o Mount Veſuvius, collected at *Naples* in the ſummer o 1794.)

a) CH. Cr. Melted into a compact glaſs, of a dirty olive-green; ſmall fragments of which tranſmitted ligh It contained ſome pieces of iron.—L. of W. 0,10.

b) CL. Cr. A denſe, browniſh-black glaſs.

No. 105. WACKE (a variety of baſalt, commonly ranked among the ſpecies of argillaceous earths); from *Joachimsthal.*

a) CH. Cr As No. 7. *b*)

Note. The ſame ſpecimen was again put into the charcoal-crucible, after it had been ſeparated from the grains of iron. When taken out, it was tuberous or knobby. The ſurface preſented a glittering black-brown incruſtation, whoſe fracture had a ſlight luſtre. But the interiour maſs had become pale-grey, and denſer than before.

b) CL. Cr. The ſame change as No. 7. *b*)

No. 106. FULLER'S EARTH (*Smectis*) genuine; from *Hampſhire.*

a) CH. Cr. A compact opake ſcoria of a dull grey, with many grains of iron.—L. of W. 0,25.

b) CL. Cr. A denſe, blackiſh-green ſcoria. Its ſmooth ſurface exhibiting red dots.

No. 107. WITHERITE; from *Anglezark.*

a) CH. Cr. In experiments repeatedly made with this ſubſtance, the inner charcoal-crucible was found conſumed for the greateſt part. Hence the witherite always entered into an imperfect fuſion with the contiguous part of the clay-crucible, which ſerved as a caſe to the charcoal-crucible.

b) CL. Cr. A green, ſomewhat turbid, and frot glaſs.

No. 108. ZEOLITE, compact, ſiliceous, (*Prehnite*) from *Scotland.*

a) CH. Cr. Fuſed into a compact, deep-grey, opa ſcoria. Fracture, imperfectly conchoidal, and high glittering. Coated with a ferruginous cruſt; and co taining a few minute grains of iron.—L. of W. 0,05.

b) CL. Cr. An opake denſe ſlag. Its ſurface oli green; the inner maſs, celadon-green, and the fractu glittering.

No. 109. ZEOLITE, radiated; from *Ferröe.*

a) CH. Cr. Swelled up into an ill-ſhaped, greyiſ white, tranſparent ſcoria; full of froth bubbles.—L. of 0,16.

b) CL. Cr. The ſame; but as white as ſnow.

No. 110. ZEOLITE, volcanic grey; (according *Fichtel*—according to others, zeolitic pitch-ſto from the Mount *Pap-Laſſo*, near *Telkebanya.*

a) CH. Cr. A glaſs of a dim, black-grey colo of a clear tranſparence on the edges; of a greaſy gl in the fracture; and ſhewing ſeparate bubbles. It alſo very ſmall grains of iron in ſeveral parts of its exter ſurface.—L. of W. 0,05.

b) CL. Cr. Yielded a denſe, bright greyiſh-wh tranſparent, but not thoroughly clear glaſs; rendered t bid by very minute froth-bubbles. Its ſmooth ſurface

ſe

ſeſſed a great ſplendour, and was marked with diſperſed brown-red ſpots, reſembling agates.

No. 111. ZEOLITE, volcanic red; from the *ſame place.*

a) CH. Cr. Like No. 110. *a*)

b) CL. Cr. Like No. 110. *b*); only ſomewhat more turbid.

No. 112. CIRCON (Jargon); from *Ceylon.*

a) CH. Cr. No change, excepting that its colour turned white-grey, and its ſurface became a little more turbid.—Alſo no L. of W.

b) CL. Cr. Likewiſe unaltered. The greeniſh colour had almoſt diſappeared, and in its ſtead ſucceeded a reddiſh, bluiſh, and in part perfectly white one. Several pieces emitted a whitiſh luſtre.—No loſs of weight.

Concerning the utility which theſe experiments on fuſion may afford in various reſpects, I ſhall make only one or two remarks.

On reviewing the diviſion of ſtones and earths into *fuſible* and *infuſible*, which has been hitherto adopted, we obſerve that ſeveral of them are claſſed among the firſt; which, however, are not fuſible of their own accord, but acquire that property only by the co-operation of extraneous cauſes. Thus, if we obſerve the *Strontionite* (No. 91), the *Compound-ſpar* (No. 16), *Sidero-calcite* (No. 20), *Marble*, (No. 56), and in general all the ſpecies of calcareous earth, to vitrify in the melting-veſſels, it is owing to the *argillaceous earth* of the clay-crucible, which by its contact effects the fuſion of thoſe ſtony matters, which, when alone, are infuſible.

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With reſpect to many other ſubſtances, the cauſe of their vitrification is their ferruginous contents; for *oxyd of iron* likewiſe promotes the fuſion of many compoſitions, otherwiſe not vitrifiable. This vitrification, therefore, cannot take place in *charcoal-crucibles*; becauſe in theſe, the calx of iron loſes its vitreſcent property, by being reduced to reguline iron, and hence is rendered incapable of continuing in chemical ſolution or combination with unmetallic-earths. It then ſeparates from them by a kind of eliquation.

An inſtance of this is afforded by the *Baſalt*, (No. 6—10), uſually repreſented as a body, which very eaſily melts into a black glaſs. But this fuſibility of baſalt obtains only when its ferruginous part finds no opportunity to b reduced and to ſeparate: for after this is withdrawn, th remaining portion of baſalt is no longer vitrifiable. It now appears, if examined by a lens, as a body almoſt wholly corroded; and it is not converted into a ſcoria, unleſs afte continued expoſure to the moſt violent fire.

It is worth remarking, that, in the charcoal-crucible not only is the iron of ſuch foſſils, as contain it in a ver ſlight quantity, as *Pumice-ſtone* (No. 15), *Boracite* (No 19), *Mica* (No. 38), completely reduced; but alſo, tha even ſome ſpecies of ſtones, which in no manner underg real fuſion, nay, which hardly ſeem to become ſofter, a the *Ligniform Aſbeſtus* (No. 11), *Chryſolite* (No. 25), *Brown red Semi-opal* (No. 65), *Praſe* (No. 72), and *Serpentin* (No. 80), do nevertheleſs depoſite, as it were by exſudation, moſt part of their iron.

The proportion of the ferruginous contents thus diſcovered, may ſerve at the ſame time to determine in dubio caſes the claſſification in the mineralogical ſyſtem. Th is to ſay. it may aſſiſt to decide, whether a foſſil, who

pr

proportion of metallic parts is as yet unknown, ſhould obtain a place in the claſs of earths and ſtones; or, whether it ought to be ranged in the genus of iron-ores.—Such is the caſe with *Umber*. Of one hundred parts of umber from *Cyprus* (No. 102), there remained 67; and the iron, reduced from this reſiduum, amounted to 37; but the vitreous ſcoria, only to 30.—Of one hundred parts of *umber* from *Cologne*, there likewiſe remained 67, of which 35 were iron, and 33 were ſcoria. This mineral, therefore, as much deſerves a place under the genus of iron-ores, as ſeveral other iron-ores, leſs rich in ferruginous contents. It may be conſidered, either as a particular ſpecies of the brown iron-ſtone; or as a variety of brown iron-ochre.

Beſides, the trials made with fire may be of ſome utility with regard to thoſe foſſils, concerning which the opinions of the learned are yet divided, with regard to the means employed by nature for their formation. I even think, that in this branch of *geological* reſearches, the experiments made by *means of fire*, are rather more deciſive than the analyſis in the *moiſt-way*. Although it is quite contrary to my intention to enter into this diſpute, yet I think myſelf obliged to ſtate my own private opinion reſpecting this ſubject, independent of the authority of others; which is, that I cannot rank among the products of fire, either the genuine *baſalt*, or its kindred *wacke*, or the *porphyric-ſlate*. In this perſuaſion I am confirmed by perſonal inſpection of baſaltic diſtricts, eſpecially of the *Bohemian middle mountains*; as well as by the habitudes of the above minerals in fire. No. 6—10; 105; 70.

On the contrary, as to what relates to the generation of the *Obſidian* (No. 58, 60), *Pumice-ſtone* (No. 15), and pretended *Volcanic Zeolite* (No. 111, which laſt is reckoned by ſome among the *Pitch-ſtones*), &c, I willingly renounce my own opinion; adding only, that, on conſidering the arguments for and againſt their volcanic origin, the circumſtance of the obſidian and pumice-ſtone giving in fire exactly the ſame products, ſhould not be diſregarded; and alſo, that both theſe foſſils, not only accompany each other at *Lipari*, but likewiſe frequently occur actually blended.

As the chemical analyſis in the humid way is embarraſſed with many difficulties, that check the progreſs of our knowledge of the conſtituent parts of foſſils; the ſpeedier examination, by means of fire, of a foſſil, not yet analyſed, may ſerve as a previous hint for aſſigning to it its proper place in the ſyſtematical arrangement. It may alſo tend to correct the claſſification of ſeveral minerals whoſe characters are not ſufficiently diſtinct, or perhaps have led to error. So, for inſtance, the above reſults plainly ſhew, that the [illegible] is not a feldſpar (No. 48, 49); that the *Leucite* does not belong to the garnets, and as little to the feldſpar (No. 56); that the [illegible]*-ſtone*, or *brown-red* [illegible], is not allied to the vitrifiable pitch-ſtones, among which it has been ranged on account of its perfect opacity (No. [illegible]); and that the [illegible] cannot be claſſed under the garnets (No. 41); nor the [illegible] under the ſtriated [illegible] (No. [illegible]); nor the [illegible], under the varieties of mica (No. 25).

However, the [illegible] from theſe experiments, [illegible] a deciſive concluſion [illegible] merely from [illegible] the analyſis [illegible]

II.

ANALYSIS

OF THE

BLACK-GREY FLINT.

(Common Flint; *Feuerſtein* of the Germans.)

In order to reduce to the requiſite moſt ſubtle pulverulent ſtate the harder kinds of ſtones, which are to be ſubjected to a chemical analyſis, I make uſe of a grinding concave ſhallow veſſel or bowl, wrought, as well as its appropriated mullar, of black-grey flint. The body, which is to to be finely ground in it, being previouſly pulverized in a poliſhed ſteel-mortar, gently ignited and accurately weighed, I moiſten with water, and continue the trituration, until the ſtone is reduced to an impalpable powder. A ſhorter or longer time is neceſſary for this operation, according to the degree of hardneſs; ſo that 100 grains of the more indurated ſpecies of gems often require triturating for three or four hours. After the finely powdered maſs is again deſiccated in the air, or in a gentle warmth, I ignite the powder, carefully collected from the triturating-diſh, in a ſilver or porcelain-crucible, with a low heat, and weigh it once more.

Stones, the hardneſs of which does not ſurpaſs tha flint, weigh then no more than at firſt. But ſuch as harder than flint, acquire an increaſe of weight; whic ſome gems, as the ſapphire, adamantine-ſpar, and ch beryl, often amounts to from 10 to 13 *per cent.*

Therefore, as this addition of weight muſt, of co be again ſubtracted from the ſum of the conſtituent of the decompoſed body, an exact chemical knowledg the ſubſtance, of which the grinding veſſel conſiſts indiſpenſable. And, no doubt, common flint woul little eligible for the grinding of hard ſtones, if, beſides ſilex, its chief ingredient, it contained other earths in quantity, which is ſtated by mineralogiſts; and of w aluminous earth is ſaid to make up from 18 to 20 par the hundred.

But from an exact and repeated analyſis of this I am convinced that the quantity of foreign earths, w are here combined with the ſilex, is far leſs conſider and that in general the ſum of them only amounts t *grain.* On this account, and conſidering the ſmall nu of grains abraded from the flint mortar, it would app ſuperfluous nicety, to bring into calculation the ſmall tional parts of the other earths, beſides the ſiliceous.

a) *Five hundred* grains of common flint, coa bruiſed, were ignited for half an hour in a covered c ble. They loſt, by this, five grains of weight, and tu greyiſh-white.

b) *A Hundred* grains of flint, reduced to the fineſt der, were mingled with three times their weight of ca pot-aſh, and expoſed to a red-heat in a ſilver-crucibl half an hour; by which management, however, the mixture did not fuſe, but continued a looſe, friable maſs. When covered with water, it was all diſſolved, without any reſidue, and afforded a ſomewhat turbid liquor.

c) By over-ſaturating this ſolution with muriatic acid, the *ſiliceous earth* was precipitated; which, after a due digeſtion, was ſeparated, waſhed, and ignited.—It weighed 97 grains.

d) The acid fluid, thus ſeparated, when ſaturated with carbonat of ſoda, let fall a browniſh earth; which re-diſſolved in muriatic acid, and left ſiliceous earth, weighing one grain after ignition.

e) The remaining muriatic ſolution afforded, with cauſtic ammoniac, a brown, mucilaginous precipitate; which, when added, while yet moiſt, to cauſtic lye, depoſited *oxyd of iron*, weighing after ignition one quarter of a grain.

f) When this portion of iron had been ſeparated, I mixed the cauſtic lye with muriatic acid to exceſs. Being then ſaturated with mild ſalt of tartar, it was put in a warm place. A ſmall portion of earth fell down; which, after gently drying, weighed one half grain, and its ſolution in ſulphuric acid afforded aluminous cryſtals. This aluminous earth would have weighed one quarter of a grain in its dry ſtate.

g) The edulcorating waters, after being collected, evaporated to dryneſs, and the reſidual ſaline maſs, again diſſolved in freſh water, depoſited three quarters of a grain more of an earth, which diſſolved in muriatic acid, with efferveſcence, and yielded ſelenite or gypſum, on dropping ſulphuric acid into it. It was conſequently *calcareous earth*,

which, if free from carbonic acid, would have amounte
half of a grain.

Hence the conſtituent parts of common flint amount
one hundred to

Ignited *ſilex* - -	c)	97	98,
	d)	1	
— — — *Lime* .	g)		0,50
— — — *Alumine* .	f)		0,25
Ignited *oxyd of iron* . . .	e)		0,25
Parts volatile in fire . .	a)		1,
			100

III. CHEMIC

III.

CHEMICAL EXPERIMENTS

ON THE

ADAMANTINE SPAR.

FIRST SECTION[*].

NATURE, inexhauſtible in its riches, has intended, as it were, to keep in activity the ardour of Naturaliſts, in the diſcovery, examination, and arrangement of the foſſil products, by preſenting new ſpecies that have remained hitherto unknown, and whoſe proper place has been too frequently miſtaken in artificial claſſifications. This truth has been confirmed, in an eminent degree, by the *adamantine ſpar.*

The native places of this ſtone are *China* and *Bengal*; and from each of theſe countries it was firſt brought to Europe, for the celebrated cabinet of *Charles Francis Greville*, Eſq. in London. The denomination of *adamantine ſpar*, given to it by Engliſh Naturaliſts, is grounded not only on its uncommon hardneſs, ſimilar to that of diamond;

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[*] Read in the Royal Acad. of Sciences at Berlin. See *Recherches chymiques ſur le Spath adamantin*; in the *Memoires de l'Acad. royale etc, Août 1786, juſqu' à la fin de* 1787. Berlin 1792.

but alſo on its application; for the Chineſe and Indian lapidaries make uſe of the powder of this ſtone inſtead of the real diamond-powder for grinding.

The firſt public notice taken of the adamantine ſpar which I know of, is contained in the ſecond Volume of *Sage's Analyſe chymique et concordance des trois regnes*; where this writer ſtates the above foſſil to be a granite, compoſed of fel-ſpar, black-ſhörl, and quarz. A more accurate account of it, together with a deſcription of its external appearance, was afterwards given by *de la Metherie* and *Abbé Hauy* in *Rozier's Journal de Phyſique*, for January and March 1787.

But as no Chemiſt has ventured to undertake its chemical analyſis, *Mr. Greville* was ſo obliging as to ſacrifice a quantity of this ſubſtance, in his poſſeſſion, ſufficient for its examination, and to ſend it me for that purpoſe.

The adamantine ſpar preſents two diſtinct varieties, according to the two different countries which give it birth. The firſt, which is found in China, when regular, aſſumes a columnar form of ſix ſides, without terminating points. The ſize of the ſpecimens which I have ſeen, was from an half to a full inch in height, and three quarters of an inch in thickneſs.

The colour of this ſtone is grey, of various ſhades, partly verging to the brown of hair. The entire pieces are opake; but in thin lamellas, and on the edges tranſparent. Its fracture is gloſſy, and exhibits a fine ſpatoſe or foliated texture; on account of which, even its outer ſurface appears finely ſtriated. Its lateral facets are moſtly coated with a delicate, firmly adhering cruſt of micaceous ſcales of a ſilvery luſtre, and in ſome places intermingled with particles of red fel-ſpar.—One ſpecimen was alſo covered with a delicate yellow *ſulphur pyrites.*

This ſtone is exceedingly hard. For this reaſon, it not only cuts glaſs with as great facility as diamond, but it alſo ſcratches rock-cryſtal and other hard ſtones, and is employed, as already mentioned, for cutting and poliſhing even gems.

Its ſpecific gravity I found to be 3,710.

An accidental characteriſtic mark of this Chineſe adamantine ſpar is, that it contains magnetic iron, diſſeminated in ſmall cryſtalline grains, which are eaſily ſeparable by means of the load-ſtone, if the ſtone has previouſly been bruiſed to a moderately fine powder.

The ſecond variety, or Indian adamantine-ſpar, from Bengal, called by the natives *Corundum*, is diſtinguiſhed from the Chineſe by a whiter colour, by a more decidedly ſparry texture; and by the magnetic iron, which it likewiſe contains, conſiſting of ſtill ſmaller grains, but not interſperſed within its ſubſtance, but merely adhering to its ſurface.

With the *Chineſe Adamantine Spar* I made the following Chemical Experiments.

By ſtrong ignition for an hour it loſt $1\frac{5}{6}$ *per cent.* of weight; but ſuffered no alteration, except having become a little whiter. Before the blow-pipe upon charcoal, it was not in the leaſt attacked, either by ſoda, or by borat of ſoda; or by the compound of phoſphat of ſoda and ammoniac (*phoſphoric ſalt of urine.*)

In order to guard againſt accidental impurities, I bruiſed the ſtone on the anvil, between many ſheets of ſtrong paper. I then picked out the pureſt pieces; heated them to redneſs, and quenched them in water. However, this operation being ſeveral times repeated, was found uſeleſs; and the hardneſs of the ſtone was not at all thereby diminiſhed. It was next triturated in an agate mortar to the fineſt powder; and upon 300 grains, or five drachms of this powder, introduced into a retort, twice its weight of aqua regia was poured. By ſtrong digeſtion, I obtained from it a golden-yellow tincture of iron. This digeſtion was once more repeated with a freſh quantity of the ſame acid. I then precipitated the diſſolved iron by cauſtic ammoniac; which precipitate, after edulcoration and ignition, was all attracted by the load-ſtone.

My next ſtep was to examine whether the decanted fluid contained calcareous earth.—For this purpoſe I combined it with mild ammoniac; but no trace of this earth appeared. Therefore the acid had only extracted that portion of iron, which is ſimply diſſeminated in the adamantine ſpar; but does not belong to its compoſition.

The powder remaining after the extraction of the iron was of a bright aſh-grey. This I mixed with double its weight of ſalt of tartar*, and ignited it in a ſilver-crucible, during two hours in a briſk fire. But on ſoftening again this maſs by diſtilled water, I ſoon perceived, that no *reſolution*, or ſeparation of parts, had taken place in the intrinſic mixture, or compoſition of the ſtone: nor did the alkaline ſolution let fall any precipitate, when ſaturated with acids.

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* Pot-aſh, or vegetable alkali, prepared from tartar.

Convinced by other experiments, that the cauſtic fixed alkalis have a ſtronger *reſolvent* power, than the mild over ſtones of a firmer texture, I reſolved to repeat the operation with the cauſtic alkali. With this view I prepared cauſtic ſoda, with all the precaution neceſſary for obtaining it in a perfectly pure ſtate.

Equal parts of this cauſtic ſalt, and of the powder of adamantine ſpar, were ſubjected to ignition in a ſilver-crucible for the ſpace of two hours. After this, the calcined maſs, which had become very compact and hard, was triturated with diſtilled water; ſuper-ſaturated with muriatic acid, and digeſted. The acid extracted merely a pale yellow tincture, which ſtill contained a ſlight ferruginous impregnation; but nothing of an earthy nature. When the reſidual powder was again waſhed, and ignited, it was of a light grey-white colour, and weighed 240 grains. So that 60 grains, making the fifth part of the firſt weight of the crude ſtone, muſt be taken for the iron diſſeminated in, and now ſeparated from it by acids.

Theſe 240 grains I mixed with four times their weight of cauſtic mineral alkali; and ignited them in a crucible made of ſilver, as long as the veſſel would bear it, without itſelf fuſing. After refrigeration, the maſs was ſo firm and ſo hard, that in order to bring it on the filter, I was under the neceſſity of ſoftening it by long tedious boiling in diſtilled water. The alkaline ſolution, ſaturated with muriatic acid, now dropped a white, very looſe earth; which, from previous conjecture, I then imagined to be ſiliceous. But this was not the caſe, for it was rapidly and clearly re-diſſolved by a ſlight exceſs of acid, and proved to be rathe aluminous on farther trial. And by accurately ſaturatin the ſolution with ſalt of tartar, I reproduced it again in th form of a precipitate, and collected it.

The powder, left on the filtering-paper, had an iſabella yellow colour, and had become looſer. I poured upon it fou parts of aqua regia; but it ſoon formed with it a thick gelatinous coagulum. Having added four parts more, I digeſte the mixture in a boiling heat. Which being done, it wa diluted with hot water, and, after filtration, ſaturated wit ſalt of tartar. By this management a white looſe eart precipitated, and was aluminous, like the preceding.

I next repeated the ſame operation with the 140 grains o the powder of this ſtone that remained in the laſt-mentione proceſs: that is to ſay, I added four parts of cauſtic ſoda and heated it to redneſs for five hours in a ſilver-crucible As in the preceding experiment, ſo in this, the maſs becam exceedingly hardened, and of difficult ſolution, even i boiling water. Its filtered lye likewiſe depoſited, on th addition of muriatic acid, a white looſe earth; which, i the ſame manner, entirely diſſolved without any turbidneſs by an exceſs of the acid. Having been again precipitate by mild alkali, I collected and added it to that which wa obtained in the laſt proceſs.

In the ſame manner, as mentioned above, I treated th reſidue that remained behind on the filter after the ſeparation of the alkaline lixivium, by digeſting it in aqua regia and the ſmall portion of earth, extracted from it, wa likewiſe precipitated by ſalt of tartar.

The undecompoſed part of the powder, which at thi period weighed 103 grains, I ſubjected a ſecond time to calcination, during five hours, being previouſly mixed with a quadruple proportion of cauſtic alkali. The reſult agreed with that of the foregoing proceſs. From the filtered alkaline ſolution of the maſs, ſoftened with difficulty, acids threw down a ſlight quantity of looſe earth; which was re-diſſolved when the acid was added to exceſs. Having been again precipitated by the addition of alkali, it was then collected.

I next put the edulcorated reſidue, weighing now but 92 grains, in digeſtion with ſix parts of nitric acid. The powder of the undecompoſed adamantine ſpar continued, as before, lying at the bottom, like an heavy fine ſand. But when the mixture had begun to boil, I perceived an unexpected alteration. The powder ſwelled; roſe from the bottom of the matraſs towards the ſurface of the liquid, and changed its ſandy appearance to that of a flocculent precipitate, nearly of the ſame form, with recently precipitated muriat of ſilver; but, on continuing the digeſtion, it again fell down in the form of an incoherent powder. This laſt acid likewiſe extracted a ſmall portion of alumine; which I collected, after precipitating it by pot-aſh.

The remaining powder of the adamantine ſpar, whoſe weight after ignition amounted to 74 grains, was treated in preciſely the ſame manner as before, only with this difference, that I increaſed the proportion of cauſtic alkali, of which I now took a ſextuple weight. After the maſs had been ignited for five hours, and refrigerated, it was found, as in every previous operation, to be very difficulty ſoluble in boiling water. At this time, by the addition of an acid to the filtered ſolution, a leſs quantity of looſe earth, than before, was precipitated; but which even now was not ſiliceous earth. Boiling nitric acid likewiſe extracted from the reſidual powder a little aluminous earth.

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When the adamantine powder, remaining after theſe repeated ſtrong calcinations with alkali, was put on the balance, its weight was found to be 60 grains. It appeare now in the form of a fine, ſiliceous earth; and in order t examine it as ſuch, I mingled it with one ounce of mil ſoda; upon which it was ſtrongly calcined in a ſmall ſilve crucible, and at length urged to fuſion. The crucible wa left uncovered; becauſe I intended to watch attentivel whether the blended maſs would efferveſce, during the action of the carbonated alkali, and thus betray a ſiliceous nature. The fuſion, however, went on without the lea frothing; and by this I was ſufficiently convinced, that th earth under trial was not yet purely ſiliceous.

The melted maſs proved, after refrigeration, to be as di ficult of ſolution in water, as before. This alkaline ly paſſed through the filter, ſhewed no appearance of havin taken up any foreign ſubſtance. It remained perfect clear and limpid, when ſaturated with acids; ſome fev hardly perceptible flocks, excepted.

I now endeavoured to ſeparate ſomething from the re due, again edulcorated, by means of ſtrong ſulphuric aci Eight times its weight of this acid was accordingly pour upon it, and again with proper precaution diſtilled off fro it to dryneſs. The reſidue, ſoftened by hot water, w put on the filter, and the acid liquor, which paſſed throu the paper, was ſaturated with pure vegetable alkali. Y even with this treatment, I only obtained a very ſlight i dication of alumine.

On conſidering this great obſtinacy of the remainder l from the adamantine ſpar, which by the laſt operation hard loſt one grain of weight, I again recurred to the cauſ mineral alkali. The powder, mixed with a tenfold qua

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tity of ſoda, was firſt ignited for four hours; increaſing afterwards the intenſity of heat, until the maſs entered into a thin fuſion, in which ſtate it was kept two hours. The ſilver-crucible would not longer reſiſt the action of the fire; it was injured, though without detriment or loſs of the maſs, which was again with difficulty liquified in water, and then filtered.

The alkaline lixivium, thus obtained, depoſited a tender earth, upon ſaturation with acids. But even this earth was not yet ſiliceous. It diſappeared by a ſlight exceſs of the acid; and ſeparated again, as ſoon as the point of ſaturation was reſtored, by the addition of alkali. When thus recovered, it was freed from adhering ſaline particles by waſhing, and added to the precipitates, obtained in the preceding operations.

Upon the remaining portion of adamantine ſpar in a pulverulent ſtate, which in this proceſs again had aſſumed an iſabella-colour, I then affuſed four parts of nitric acid. The mixture thickened to a jelly; on which account I added four parts more of nitric acid, and digeſted it in a boiling heat. The ſolution being diluted with water, and filtered, was ſaturated with ſalt of tartar; and the precipitate which it afforded, added to the preceding ones.

At this period, the quantity of adamantine ſpar, which had hitherto reſiſted decompoſition, weighed 34 grains; which were mixed with 15 times their weight of cauſtic ſoda, and ignited in a briſk fire, during five hours. Yet, notwithſtanding this, the alkaline lye, procured from the re-diſſolved maſs, and ſaturated, depoſited only a trifling quantity of a flocculent earth; and for this reaſon no diminution of weight was obſervable in the reſidue.

Digeſted with eight parts of nitric acid, the mixture again acquired a gelatinous conſiſtence: and the acid, ſeparated by filtering, likewiſe afforded only a ſcanty precipitate, on being ſaturated with alkali.

The powder, ſtill undecompoſed, weighed now 27 grains; which I blended again with 15 parts of cauſtic ſoda, and treated in the manner oftentimes ſtated. But I obſerved that the alkali, as well as the ſubſequent digeſtion in acids, extracted from it ſtill leſs than before; ſince the remaining undecompoſed part amounted yet to 24 grains.

I then reſolved to try, whether perhaps a ſtronger degree of heat, than the ſilver-veſſel was capable of bearing, might not give additional force to the action of the alkaline ſalt, and thus effect the farther decompoſition of this ſtubborn reſidue. I therefore ſubſtituted an iron-crucible to that of ſilver. This reſidue, being mixed with four parts of mild pot-aſh, and introduced into the iron-crucible, was expoſed to a heat ſufficiently intenſe to cauſe it to melt, and it was then kept for two hours in red fuſion. This obſtinate body, however, could not be maſtered. The liquor, ſeparated from the diſſolved maſs, held no atom of earth in ſolution; but remained clear, when ſaturated with acids.

After the reſidue, left on the filtering paper, had been freed by means of the muriatic acid from the particles of iron which it had acquired from the melting-veſſel, and after it had been edulcorated and dried, I found it poſſeſſed of the ſame nature as before; and only one grain of its weight was wanting, which I ſuppoſe was not diſſolved, but loſt.

Having thus *eleven times* calcined and fuſed this ſtone with alkali in various proportions, I at laſt gave up all hopes of conquering this reſidue, which at each operation proved more and more refractory. And not expecting ſucceſs, even from repeating theſe tedious proceſſes, that exhauſted all patience, I turned my attention to the examination of the ſeveral precipitates that had been collected.—But I found that thoſe which were obtained, by means of acids, from the ſolutions of the maſſes calcined with alkali, were of nearly the ſame nature as the precipitates, thrown down by alkalis from the acids, in which the adamantine ſpar was digeſted or extracted after every calcination. For this reaſon I mixed them all together, and choſe the ſulphuric acid, as the proper teſt for their examination. This menſtruum, conſiſting of one part of the concentrated acid, diluted with four parts of water, immediately diſſolved a conſiderable part of the earthy precipitate; but another portion remained undiſſolved, though the acid had been added to exceſs, and was aſſiſted by a boiling heat. Upon this undiſſolved earth, when ſeparated by filtration, edulcorated, dried, and introduced into a retort, I poured four times its weight of concentrated ſulphuric acid; and having again abſtracted this laſt, by diſtillation, to dryneſs, in a ſand-bath, I ſoftened the reſiduum with boiling water, placed it on the filter, and edulcorated the earth remaining on the paper. I found, however, that by this treatment, nothing of importance could be extracted from this earth; for the ſolution, ſaturated with alkali, yielded only one half grain of precipitated aluminous earth, which I re-diſſolved in ſome drops of ſulphuric acid, and added to the preceding ſolution

A ſmall proportionate quantity of pure vegetable alkali being added to this ſolution, it was made to cryſtallize by repeated gentle evaporations; after which it ſhot into regular cryſtals of alum, which were collected.

I obſerved, however, that on every cryſtallization of this ſolution of alum, a *white ſlimy* earth was ſeparated.

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I therefore collected it carefully, and treated it in the ſame manner as the earth mentioned before: that is—I diſtilled from it four times its weight of ſtrong ſulphuric acid; ſoftened the reſiduum in the retort with water; filtered the liquid which had diſtilled over, and ſaturated it with alkali. But hardly one half grain of earth fell down, and this was ſtill aluminous. The earth which remained undiſſolved, exactly reſembled that which has been mentioned before, and was accordingly added to it.

Thus I at length ſo far ſucceeded, as to decompoſe the adamantine ſpar into two different ſpecies of earth. But though the firſt evidently ſhewed itſelf to be aluminous, the nature of the ſecond was doubtful. On ſuperficial conſideration, this laſt might well be taken for ſiliceous earth; but its habitudes contradicted this ſuppoſition.

Encouraged by the hope of coming nearer to the diſcovery of its true nature, I repeated the operation ſo frequently noticed, of heating it to intenſe redneſs for ſome time, with ſix parts of cauſtic ſoda in the ſilver-crucible, and increaſing at laſt the ſtrength of the fire ſo as to affect its thorough fuſion. The melted maſs had then acquired a ſtriated cryſtallic texture. Yet the alkali took up but a ſmall portion of it, as I found by the weight of the undiſſolved earth, recovered from the calcined maſs, after liquefying it by water. The reſidue, waſhed and dried afreſh, was boiled for an hour with ten times its weight of ſtrong nitric acid; from which, when ſeparated again, and ſaturated with alkali, only an inconſiderable trace of alumine fell down.

I then ſaturated with nitric acid the alkaline ſolution obtained from the melted maſs. It let fall a ſlight quantity of fine a fine earth; not a particle of which was diſſolved by nitric acid boiled upon it for ſome time.

This portion of earth, which was precipitated, and recovered by filtration, ought at laſt, agreeably to theory, to have aſſumed the character of pure ſiliceous earth. To make trial of it, I expoſed it with ſoda to the action of the blow-pipe, in a quantity not exceeding three grains. But it did not prove to be ſiliceous; on the contrary, I found it to be of the ſame nature with the whole of the remaining earth, from which it was ſeparated by the mineral alkali during the fuſion.

However, in order to make a comparative experiment with real ſiliceous earth, I mingled a drachm of this laſt, precipitated from liquor of flints, with four drachms of cauſtic ſoda, and expoſed them together, in a ſilver-crucible, to only a moderate ignition. Although this maſs was hardly agglutinated by the operation; yet it eaſily afforded a clear ſolution in diſtilled water. And when this was ſaturated with an acid, the ſiliceous earth fell down, in its uſual manner, in the form of a jelly-like ſubſtance, highly intumeſced.

From all theſe proceſſes it is ſufficiently obvious, that the adamantine earth in no manner acts like the ſiliceous. If it were ſo, it ſhould diſſolve in fixed alkalis, by means of a red heat; more eſpecially when cauſtic alkalis are employed, as was here the caſe: and it likewiſe ſhould be recoverable from them by affuſion of acids. But the earth, which after the firſt fuſions, was thrown down by acids from the alkaline ſolutions, was not ſiliceous, but aluminous, which was immediately and entirely re-diſſolved by adding more of acid. And in proportion as the alumine was ſeparated from the *mixture of the* adamantine ſpar, by alkalis as well as by acids, the unknown earth in queſtion more and more reſiſted each ſolvent medium.

If ſiliceous earth, blended with equal parts, or with only one half of its weight of fixed alkali, be expoſed to a melting heat, it unites with ſtrong efferveſcence to the alkali, and affords a clear glaſs. And this reſult enſues both in the crucible, and before the blow-pipe, in ſmall experiments. But this is not the caſe with the other earth. When brought before the blow-pipe in a ſmall ſilver ſpoon, a little efferveſcence ſeems indeed to take place at the beginning of the fuſion; but neither is the efferveſcence ſo ſtrong, nor is there a clear vitreous globule formed, as in the firſt inſtance. Only a ſcorious maſs, of difficult fuſion, remains.

A frit, compoſed of twenty grains of this earth, with as much carbonated ſoda, was expoſed in a luted clay-crucible, to the ſtrongeſt heat of the porcelain-furnace, which is ſo intenſe, that carrara-marble, or any other calcareous earth, if incloſed in a clay-crucible, melts without any addition, into a very hard, clear, and green glaſs. The reſult of this experiment was, an opaleſcent, very hard, greeniſh-white glaſs; the fracture of which, however, exhibited ſigns of a texture, in divergent lines, radiated from a common centre at the bottom of the melted maſs. Whereas ſiliceous earth, precipitated from the liquor of flints, when mingled with equal parts of ſoda, as was to be expected, yielded a clear glaſs in the ſame degree of heat.

What am I then to think of this earth? Shall I, perhaps, take it for a mixture as yet not totally decompoſed of two or more ſimple earths, perhaps the aluminous and ſiliceous?—This opinion is *not without probable ground*. The extreme obſtinacy with which the adamantine-ſpar *reſiſts* all attempts to decompoſe it, ſhews us the high degree of attractive power, by which nature has moſt intimately mixed and united the conſtituent parts of this ſtone. Hence, in proportion as the aluminous earth was forced out and ſeparated from the mixture of this ſtone, ſeemed the laſt reſidue, which, for a moment, I will ſuppoſe to be ſiliceous, to be more ſtrongly attracted, and ſecured againſt farther ſolution, by its other remaining conſtituent parts, in the ſame manner, perhaps, as ſilver is defended by gold from the attack of nitric acid, when the firſt is united with the latter by fuſion, in a proportion ſmaller than two to one.

But this *analogy* ſubſiſts only in appearance, and it might be applied only in the decompoſition of the adamantine ſpar, by means of acids. For, in that caſe, the ſiliceous earth, becauſe itſelf inſoluble in acids, might protect the alumine which is moſt intimately combined with it; in the ſame way as gold, by its inſolubility in nitric acid, preſerves the ſilver againſt the action of the ſame acid, which in general ſo readily diſſolves it. On the contrary, this example does not ſeem very applicable to the decompoſition of this ſtone, in the dry way, by means of alkali; ſince, in this caſe, both earths, the alumine as well as the ſilex, are ſoluble in fixed alkalis.

Beſides, the above conjecture is oppoſed by another circumſtance. We are taught, by experience, that mixed bodies, whoſe conſtitutent parts are ſtrongly attracted by each other, may certainly, for a long time, reſiſt the force of ſolvents; but we alſo know, by experience, that, whenever the ſolution has actually taken place, eſpecially when in the humid way, the reciprocal attractive power of the conſtituent parts is then either totally deſtroyed, or, at leaſt, ſo far diminiſhed, that nothing impedes their ſeparation.

This is the caſe with the earth of the adamantine ſpar: for it has actually been diſſolved, conjunctively with the aluminous earth, partly in acids, partly in the alkaline lyes. And it has alſo been recovered, in the form of a precipitate, from both kinds of ſolvents.

What inference, therefore, remains?—This earthy ſubſtance would not give any further indications of a mixture; and yet it preſented none of the ſpecific characteriſtic marks by which the other ſimple earths, at preſent known, are diſtinguiſhed. Are we not, then, authorized to regard this body as a *new*, *diſtinct*, *ſimple* earth?—However, I do *not* venture, at this time, poſitively to decide on this point. Before this can be done, *repeated experiments muſt throw more light on the nature of this earth.* Yet, conſidering the ſcarcity of adamantine ſpar, and its diſcouraging reſiſtence to chemical analyſis, there is little hope for a ſpeedy ſucceſs.

It now remains, to ſtate the *proportion* of the parts found in the adamantine ſpar.—The grains of *magnetic iron* diſſeminated through it, conſtituted the fifth part of its whole weight; for when they had been ſeparated, there remained 240 grains of the 300 employed. But this iron cannot be brought into the computation as a conſtituent part of the ſtone.—Its proper conſtituent parts are, *aluminous earth*, and the above *yet undetermined earth*. After all the aluminous earth, collected in this analyſis, had been diſſolved in ſulphuric acid, and properly cryſtallized, I obtained from it 2 ounces 6 drachms of alum, in regular cryſtals. As, therefore, the alumine contained in one ounce of this neutral ſalt, amounts, when ignited, to 56 grains, it is manifeſt, that thoſe 2 ounces 6 drachms of cryſtallized alum contain 154 grains of aluminous earth, free from water.

The other yet undetermined earth weighed, after ignition, 53 grains. To theſe muſt be added the reſidue of 24 grains, which remained at laſt, on the decompoſition of the ſtone, and was inſoluble, and perfectly like the other portion. Hence this earth amounts, in the whole, to 77 grains; which, with the 154 grains of aluminous earth, give the ſum of 231 grains.

SECOND SECTION.

THE circumſtantial deſcription of my firſt analytical attempt reſpecting the adamantine ſpar (communicated in the foregoing ſection), may ſerve as an example to ſhew the difficulties chemiſts have but too often to contend with, when examining unknown natural bodies. If the method of decompoſing hard ſtones, purſued in my former enquiry, be compared with the proceſs which will be explained in the preſent ſection, it will alſo appear from thence, how ſeemingly unimportant the cauſes often are which at one time enſure ſucceſs to the undertaking, at another time render it difficult.

By the reſults of the above experiments, I was induced to enquire, whether that earthy body, which was obtained beſides the aluminous earth, did not deſerve to be conſidered as a new, peculiar earth. However, I accompanied this conjecture with the expreſs declaration, that I did not then mean to aſſert any thing certain; but, on the contrary, that farther experiments could alone decide that queſtion. Nevertheleſs, I find this ſubſtance mentioned by ſeveral authors as an earth, the exiſtence of which has been already proved, and named by them *Earth of Adamantine Spar*, *Corundum-earth*, *&c.*

On this account, I thought myſelf the more bound to make new reſearches on the adamantine ſpar, and to give, if poſſible, a *complete decompoſition* of it, inſtead of the former preliminary and unfiniſhed examination. Two reaſons impoſe upon me this taſk; either to throw full light upon its nature if it ſhould, on farther examination, prove to be really a diſtinct and new earth; or, if the contrary be the caſe, to prevent in time the ſpread of an error, occaſioned againſt my intention.

The want of a ſufficient additional quantity of this foſſil, which ſtill continues to be ſcarce in Europe, has, however, retarded the execution of this purpoſe for a conſiderable time; but other experiments, conducted during that period, have made me acquainted with a ſhorter and more certain method of analyſing gems, and other ſimilar foſſil bodies of difficult decompoſition.

A.

Decompoſition of the Chineſe Adamantine Spar.

a) *Hundred and fifty* grains of hair-brown adamantin *ſpar*, from *China*, containing interſperſed particles of magnetic iron, were powdered by gentle blows in a mortar o poliſhed ſteel, and the grains of iron extracted with th load-ſtone. The ſeparated iron weighed 18 grains.

b) *Hundred* grains of the powder from this ſtone wer then weighed, and moſt finely levigated, moiſtening the with water, in a triturating-diſh, made of flint. After deſiccation the powder appeared of a grey colour, reſembling th of wood-aſhes, which paſſed into a brown-red, after gentl ignition. It now weighed 110½ grains, and conſequently had received an increaſe of 10½ grains of ſiliceous earth fro *the grinding-veſſel*.

After

c) After this it was mixed in the ſilver-crucible with 4 ounces of cauſtic lixivium, prepared from the pureſt vegetable alkali, the ſaline contents of which lye amounted to one half of its weight; and after this the fluid was again evaporated, till the maſs was dry. This done, the crucible was removed into the wind-furnace; applying at firſt a moderate heat, and increaſing it gradually, until the crucible was red-hot; in which ſtate it was kept for 3 hours.

d) Upon the refrigerated maſs, which had acquired a brown colour and conſiderable hardneſs, I repeatedly poured hot water, to ſoften it by degrees. The ſeveral waſhings being collected in one glaſs, there fell down a looſe earth of a deep ochre-yellow tinge, which, when ſeparated by filtration from the clear liquid, and dried in a gentle heat, weighed 58 grains.

e) Muriatic acid threw down from this alkaline ſolution a copious precipitate, which was again wholly diſſolved by a ſlight ſuper-ſaturation with the acid. When decompoſed by a boiling ſolution of carbonat of pot-aſh, it produced a white looſe earth, the quantity of which amounted, after gentle deſiccation, to 201 grains.

f) The above 58 grains of yellow earth (*d*) were covered with muriatic acid, and committed to digeſtion. It diſſolved in it to a yellow liquid, ſomewhat turbid, which ſoon after formed a gelatinous coagulum. After being diluted with more water, and digeſted, ſtirring it now and then, it depoſited *ſiliceous earth*, which, when ignited, gave 4½ grains in weight.

g) I then added mild vegetable alkali to the clear yellowiſh ſolution, ſeparated from the ſiliceous earth by filtering. The browniſh precipitate, which I thus obtained, was ſufficiently edulcorated, and, while yet moiſt, boi with cauſtic lye. There remained a brown reſiduum, c ſiſting of 15½ grains, after a gentle drying.

h) Theſe 15½ grains diſſolved in the cold, in the mu tic acid poured upon them, and afforded a ſaffron-yell ſolution, but which ſpeedily congealed to a jelly. Fr this laſt, diluted in heat with water, there ſeparated *ſilice earth*, whoſe weight, after ignition, was 3 grains.

i) From the muriatic ſolution (*h*) I now precipitated, cauſtic ammoniac, the iron which it contained. It down in brown-red flocks, and weighed 7½ grains, af being expoſed to a red-heat.

k) From the alkaline ſolution (*g*), ſaturated to exc with muriatic acid, the addition of mild vegetable alk precipitated, in a boiling heat, a white looſe earth, whi being gently dried, weighed 29½ grains.

l) Upon theſe 29½ grains of earth (*k*), added to the ab 201 (*e*), dilute ſulphuric acid was affuſed. When gen warmed, the earth was entirely diſſolved; but when ſolution had been concentrated by evaporation, it coa lated into an uniform clear jelly. This was again piouſly diluted with water, in a warm temperature, with repeated ſtirring; upon which *ſiliceous earth* ſe rated, amounting, when dried and expoſed to a red-he to 9 grains.

m) The clear ſolution by ſulphuric acid (*l*) was now co bined with the requiſite quantity of vegetable alkali, by ſlow evaporation made to cryſtallize. It conſtan yielded, until the end, regular cryſtals of alum. T laſt remaining liquor, which conſiſted only of a few drops, I dried to a ſlimy conſiſtence, which, upon dilution with water, ſtill depoſited ½ grain of *ſiliceous earth*.

η) After all the cryſtals of alum, collected from the ſeveral liquors, had been re-diſſolved in boiling water, I precipitated their earth by carbonat of pot-aſh, waſhed, and dried it. But as the aluminous earth is much diſpoſed, even after the moſt diligent edulcoration, firmly to retain a portion of the ſalts, that before were combined with it, more eſpecially the vegetable alkali, whereby its own weight is neceſſarily increaſed; I took care to reſtore it in its true purity, by affuſing upon it twelve times its weight of diſtilled vinegar, digeſting it for ſeveral hours with this fluid; then adding as much cauſtic ammoniac as would ſaturate the acetic acid to exceſs; and laſtly, by a perfect edulcoration of the precipitated *alumine*. When it was afterwards deſiccated and ignited, its weight was found to be 84 grains.

θ) At laſt, the *ſiliceous earth* was put to trial. For this purpoſe I heated it to redneſs with four times its weight of mild vegetable alkali, and poured water on the maſs which was obtained. It was completely diſſolved, leaving only a ſlight portion of a ſlimy reſidue; and depoſited again, during ſaturation with muriatic acid, the ſiliceous earth in its uſual form.

Thus the decompoſition of the adamantine ſpar was fully effected; and every uncertainty reſpecting the true nature of its conſtituent parts, that had remained after its firſt examination, is totally removed.

Hence, when we reflect that the magnetic iron, diſſeminated in the Chineſe adamantine ſpar, is merely to be con-

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conſidered as a foreign ſubſtance mingled with it, and therefore cannot be conſidered as a conſtituent part, the following will be the *conſtituent parts of adamantine ſpar*, together with their proportions in the *hundred*.

Alumine	*n*)		84,
Oxyd. of iron . .	*l*)		7,50
Silex	*f*)	4½	
	b)	3	
	l)	9	
	m)	½	
		17	
From which ſubtract	*b*)	10½	
There remain . .		6½ . . .	6,50
			98
		Loſs . .	2
			100

B.

Decompoſition of the Adamantine Spar from Bengal.

THE *Bengal Adamantine Spar*, or *Cerundum Stone*, differs from the Chineſe; *firſt*, in containing no interſperſed magnetic iron, of which only now and then ſome few grains adhere to its external ſurface; and, *ſecondly*, in this, that the ferruginous part, belonging to its chemical mixture, is leſs conſiderable. For this reaſon the whitiſh grey colour of that ſtone is brighter, its thin lamellas more tranſparent, and, as it appears, the hardneſs of the ſtone is in ſome degree greater.

a) When pounded in the ſteel-mortar, it afforded a white powder, inclining to pearl-grey. One *hundred* grains of it, triturated with water in the flint-mortar, I found, after drying and ignition, to have increaſed 11 grains in weight.

b) Upon theſe 100 grains, four ounces of cauſtic lixivium, containing one half its weight of cauſtic alkali, were affuſed in the ſilver crucible; and the fluid evaporated to dryneſs. The maſs being then ignited for three hours, with the neceſſary precaution, it was again ſoftened by drenching it with water, and afterwards filtered. There remained a grey-white reſidue, weighing 47 grains when dry.

c) The alkaline fluid (*b*) let fall, during ſaturation with muriatic acid, a copious, white, and looſe earth; which was immediately re-diſſolved by a ſlight exceſs of the acid.

d) The above-mentioned 47 grains of earth (*b*) completely diſſolved in the muriatic acid. When this ſolution was mixed with cauſtic ammoniac, it afforded a ſlimy and very puffy precipitate. Mild ammoniac was then added to the liquor, which had been immediately ſeparated from this precipitate by filtering, but it produced no farther precipitation.

e) I then put into cauſtic lye the ſlimy precipitate (*d*), moiſt as it was, and digeſted them together. The mixture aſſumed the appearance of a thickiſh ſolution of gum-arabic. On adding more cauſtic lye, the whole was diſ-

ſolved

ſolved into a limpid liquor, except ſome brown flocks, which in the dry ſtate, conſiſted of 2 ¼ grains.

f) Muriatic acid being affuſed upon this flocculent precipitate (*e*), a ſmall portion of *ſiliceous earth* ſeparated, an cauſtic ammoniac precipitated from the clear ſolution a *oxyd of iron*, weighing, after ignition, 1 ¼ grain.

g) From the alkaline ſolution (*e*), the muriatic acid threv down a quantity of ſlimy earth, which was entirely rediſſolved by a ſmall over-proportion of that acid.

h) Both the ſolutions (*g*) and (*c*), were next united an precipitated by carbonated pot-aſh in a boiling-heat, and th dried precipitate was again diſſolved in dilute ſulphuri acid. When this ſolution, after the addition of a ſufficien quantity of vegetable alkali, had been evaporated to the poin of cryſtallization, it readily afforded clear and regula cryſtals of alum, or ſulphat of alumine.

i) The remaining part of the ſolution in ſulphuri acid *(h)* thickened ſpontaneouſly to a clear jelly, on ſubſequent evaporation. This gelatinous matter, after bein digeſted with an abundant quantity of water, and repeatedl agitated, again liquefied by degrees. Upon this, ſom *ſiliceous earth* ſubſided; which, when ſeparated by means o a filter, dried up in a raiſed temperature, in the forn of tranſparent ſhining grains. It was levigated, togethe with the foregoing *(f)*, and once more boiled with ſulphuri acid. When dried again, and ſubjected to a red-heat, it weight amounted to 15 ½ grains.

k) The above ſolution in ſulphuric acid *(i)*, was the evaporated for further cryſtallization It continued to the end to yield ſucceſſively regularly cryſtallized ſulphat o alumine: but the very laſt portion was ſtill contaminated with *ſiliceous earth*, amounting to 1 grain after ignition.

l) All theſe ſeveral portions of alum were diſſolved in water, and precipitated in a boiling heat by carbonat of pot-aſh: and when the earthy precipitate which they afforded had been depurated by means of acetic acid, as explained in the preceding ſection, they gave 89½ grains of ignited *aluminous earth.*

Therefore, the products obtained by the decompoſition of the *Adamantine Spar from Bengal* conſiſt of

Alumine	*l)*		89,50
Oxyd of iron . . .	*f)*		1,25
Silex	*i)*	15½	
	k)	1	
		16½	
Subtract	*a)*	11	
Remain	.	5½	5,50
			96,25
		Loſs . :	3,75
			100

The very predominant proportion of the aluminous over the ſiliceous earth, exhibited by this decompoſition of both varieties of the adamantine ſpar, affords a new proof, that alumine is ſuſceptible of a greater coheſive power than ſilex is poſſeſſed of. Hence nature may form ſtones of extreme hardneſs almoſt entirely from aluminous earth; of which my

lyſis of the *Sapphire* will give, in the ſequel, a very ſtriki
inſtance. On the contrary, it is evident that this does
hold good with reſpect to the ſiliceous earth, as appe
from *rock-cryſtal*, its pureſt form; for, how inferior is t
laſt in hardneſs to the ſapphire, as well as to the adam
tine ſpar!

On analyſing the Chineſe adamantine ſpar, we find t
it was ſiliceous earth that remained, when muriatic a
was poured upon that portion, which was not diſſolved
the alkali during ignition. But, on analyſing the Ben
diamond-ſpar, this earth did not appear before the ſoluti
of the aluminous earth in ſulphuric acid was prepared
cryſtallizing by evaporation; and at that period this a
cauſed it to coagulate into an uniform, colourleſs, gelatin
ſubſtance. This laſt circumſtance is frequently attended
a phenomenon which ſeldom occurs, and is quite differ
from thoſe which we uſually obſerve on the efloreſci
of ſalts. It is, that the maſs, when coagulated to a cl
jelly, branches out in ſeveral places, and forms ſepara
unconnected figures, often in the ſhape of four, five, and ſ
ſided longiſh pyramids, and often merely as conical point

Similar phenomena take place, whenever the alumin
earth has entered into intimate union with a ſmall porti
of the ſiliceous, as will be ſeen by the following expe
ment:—I mixed 2 drachms of liquor of flints, the ſilice
earth of which amounted to 10 grains, with 2 ounces of
ſolution of alumine in cauſtic lye; and ſaturated the mi
ture with muriatic acid. The earth, thus precipitat
again diſſolved into a limpid liquor, on the affuſion of
ſmall exceſs of acid. When a ſecond time precipitat
by carbonat of pot-aſh, and dried, it weighed 70 grai
I then poured upon it dilute ſulphuric acid, and found
entirely diſſolved, without depoſiting the ſiliceous ea

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with which it was combined. After being in ſome degree evaporated, part of the ſolution ſhot into ſeparate cryſtals of alum; and the remaining part coagulated in the form of a clear jelly, on the ſurface of which, after ſome days, cryſtalline pyramids ſprouted out. And when I had afterwards digeſted this jelly with a large quantity of water, the ſiliceous earth ſubſided; and, being waſhed and ignited, it weighed again very nearly 10 grains.

However, this jelly, which is frequently colourleſs, and is formed by a ſolution of ſulphat of alumine, in intimate chemical combination with finely diſſolved ſiliceous earth, and gently evaporated, ſhould not be confounded with the coagulum, which always takes place whenever the ſolution of aluminous earth in ſulphuric acid has not been blended with the quantity of pot-aſh requiſite to the formation of perfect cryſtals. This laſt forms an opake maſs, of a foliated texture, and ſoft, greaſy conſiſtence.

It yet remained to enquire into the cauſes which rendered my firſt analyſis of the adamantine ſpar ſo very difficult. That one day is improved by another, is a truth which any attentive chemiſt has often had opportunity to experience in a very conſpicuous manner. The method of preparing hard ſpecies of ſtones, recommended by *Marggraf*, *Bergmann*, and others, in order to weaken the coheſion of their parts, conſiſts in igniting them, mingled with a mild fixed alkali. But when I obſerved, that this way of preparing them would not anſwer the purpoſe in moſt of the ſtones belonging to the claſs of gems; and when I conſidered that, in the ſtrict ſenſe, it was only the portion of alkalis free from carbonic acid, which is active in this operation, I tried to ſubſtitute cauſtic alkalis to the carbonated, and found that, by their aſſiſtance, I attained my end with greater facility and certainty. The application cauſtic alkalis, in the dry ſtate, is, nevertheleſs, attend with ſeveral inconveniences. One, and not the leaſt them, is, that by triturating them with the body to be ſu jected to analyſis, no very accurate mixture will be obtaine Another circumſtance, which embarraſſed my firſt analyſ of the adamantine ſpar, is, that in every attempt I ſubjecte it to ignition in a briſk fire, with the view of aſcertainin immediately the quantity of any portion which remaine undiſſolved, or which was precipitated from its ſolutio But in this way the ſtone was rendered progreſſively mo incapable of farther ſolution; and not only its ſolubility, i ſo far as it had been promoted by ignition with alkali, b alſo the advantage obtained in leſſening the coheſive for of its conſtituent parts, have been again loſt.

How greatly the decompoſition of the harder gems promoted by the uſe of cauſtic fixed alkalis in the liqui ſtate, combined with the other requiſite methods of trea ment, may be proved by the ſecond analyſis of both th Chineſe and Bengal adamantine ſpars.

IV.

EXAMINATION

OF THE

ORIENTAL SAPPHIRE.

It ſeems to be yet doubtful, whether the modern *ſapphire* be the ſame gem which the ancients have denoted by this name. For we do not perceive in our ſapphire the diſſeminated golden points, mentioned by them as one of its eſſential characteriſtic marks; whence *Theophraſtus*[*] calls it χρυσόπαστος, and *Epiphanius*[†], χρυσοστιγής. It is, however, certain, from a paſſage of *Pliny*, that the ancients did not underſtand by it the κυανος, or *lapis lazuli*, which uſually contains interſperſed ſpeckles of a golden luſtre; but they have well diſtinguiſhed both ſpecies of ſtones. *Ineſt ei* (Cyano) *aliquando et aureus pulvis, non qualis in ſapphirinis. Sapphirus enim et aureis punctis collucet.* Plinius, libr. 39. c. 9.

The gem that we call *ſapphire*[‡] is remarkable by its blue colour, which is ſo very pleaſing to the eye, by its extreme hardneſs, and the high brilliancy which it ſhews when poliſhed. Its ſpecific gravity I have found to be 3,950, in

thoſe

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[*] de Lapidibus.

[†] de XII. gemmis, quæ erant in veſte Aaronis.

[‡] For the ſake of the leſs informed, I add, (perhaps not quite ſuperfluouſly) that the foſſil, which is ſold by Dutch druggiſts

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thoſe ſpecimens, which were the ſubject of the follo analyſis, and conſiſted of clear, longiſh-round, ab. grains, of a pure azure colour.

According to the ſtatement of the conſtituent pa the ſapphire hitherto given, and grounded on *Bergm* analyſis, an hundred parts of it are ſaid to contain:

35	*Silex*
58	*Alumine.*
5	*Lime.*
2	*Iron.*

But the following analyſis, begun and ended wit greateſt poſſible accuracy and precaution, will ſhew th above ſtatement was very incorrect.

a) *Hundred* grains of ſapphire, previouſly pounded moderately fine powder in a poliſhed ſteel mortar, moſt finely triturated with water in a grinding-diſh of When this ſapphirine powder had been dried, fully collected, and ignited, I obſerved, that its had increaſed 12½ grains from the ſiliceous earth grinding veſſel.

b) Two ounces of muriatic acid were poured upon 112½ grains in a phial ſo as to cover them, and the was repeatedly digeſted with a moderate heat. T tered acid, mixed with the edulcorating water, wa

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for *ſapphire*, in the ſhape of ſmall, heavy, black-grey, an nally reſplendent grains, and which, ſince the belief in the nal virtues of gems, has loſt ground, is now kept in th merely as an uſeleſs drug, is nothing elſe but *magnetic oct* *iron*, which in Ceylon accompanies the ſapphire, hyacint other gemmeous ſtrata, and, together with thoſe ſtones, is ed by waſhing off the ſand.

ſaturated, in a boiling heat, with mild alkali prepared from tartar, by which there ſeparated yellow flocks, weighing two grains when dry. Theſe being again diſſolved in muriatic acid, and precipitated by cauſtic ammoniac, I tranſferred the precipitate, while yet moiſt, into boiling cauſtic lixivium. It depoſited *oxyded iron*, which, after ignition, weighed *half* a grain. The aluminous earth, taken up by the cauſtic lye, was again ſeparated from it, and found to weigh *one* grain.

c) After this extraction by muriatic acid, as much cauſtic lye was affuſed on the ſapphirine powder, placed in the ſilver crucible, as was neceſſary to make the cauſtic alkali, contained in it, amount to ſix times the weight of the powder. It was next evaporated in a ſand-heat, till the maſs was dry; upon which the crucible was placed in the furnace, ſurrounded with charcoal, and ſubjected to a red heat for two hours. The contents of the crucible returned from the fire in the form of a whitiſh, looſe, and friable maſs.

d) This maſs was ſoftened with hot water, and put on the filter. There remained a bluiſh-grey, ſlimy reſidue, which, being dried, gave a powder of little coheſion, weighing 34½ grains. On adding muriatic acid, it readily diſſolved; but congealed ſoon after to a turbid jelly. By dilution with water, and digeſtion, ſome earthy particles were depoſited, which, after waſhing and drying, amounted to 14 grains.

e) When theſe flocculent particles had been removed, the muriatic ſolution was ſaturated with cauſtic ammoniac; and the reſult was an intumeſced, tranſparent precipitate, which, being previouſly edulcorated, was digeſted, while yet moiſt, in cauſtic lye. It readily diſſolved in it; with the exception of a few brown flocks, which, when col ed and ignited, weighed one fourth of a grain, and *oxyd of iron.*

f) The alkaline ſolution *(e)* was decompoſed by m atic acid; and the precipitate which it afforded re-diſſo by a ſlight exceſs of that acid. Upon this, the earth again precipitated by mild vegetable alkali, in a boi heat. The weight of the earth obtained in this part o proceſs was 16 grains, after it had been waſhed and drie

g) In the ſame manner I combined with muriatic the preceding alkaline ſolution *(d)*, obtained by ſofte the ignited maſs. There reſulted from it a copious w precipitate; but which was again totally diſſolved, l ſlight over-ſaturation with muriatic acid. The earth then precipitated afreſh by mild vegetable alkali, aſſiſte a boiling heat; and was found to weigh 289 grains, w waſhed and deſiccated.

h) To this earth I added the above 16 grains *(f)*, as the one grain of *(b)*; and poured upon the whole d ſulphuric acid. The ſolution, which was eaſily bro about in a moderate temperature, again depoſited *grains* on cooling.

i) Theſe eight grains, together with the 14 of *(d)*, b then mixed with ſix times its quantity of cauſtic lye, inſpiſſated, and heated to redneſs. The maſs, thus tained, and afterwards liquefied in water, left, on filteri grey reſidue, weighing 17 grains after deſiccation, w ſoon were diſſolved by the affuſion of ſulphuric acid, l ing ſome few, inconſiderable particles behind. The a line ſolution, when ſaturated with muriatic acid, conti at firſt limpid; but it depoſited *four grains* of ſiliceous earth, when evaporated in a warm temperature.

k) I now mixed the ſolutions in ſulphuric acid, mentioned at (*b*) and (*i*); added to them a proportional quantity of carbonated pot-aſh, and, by gentle evaporation, cauſed them to ſhoot into cryſtals. At firſt, fine, pure, and regular cryſtals of ſulphated alumine were formed: but the remaining liquor, while further evaporating, congealed into a clear, gelatinous matter, without any diminution of its tranſparency. Having poured upon it a quantity of water, I ſubjected it to continued digeſtion, ſtirring it now and then. By this management I effected the thorough ſeparation of the finely divided ſiliceous earth, which was the cauſe of the coagulation; inſomuch, that I was enabled to collect it on a filter. This *ſiliceous earth*, carefully collected, together with the above four grains (*i*), weighed 11½ grains.

l) The remaining ſulphuric ſolution, freed from its ſiliceous contents, was now ſet to cryſtallize. However, the laſt portions of alum indicated, by their lemon-yellow tinge, that they ſtill contained ſome metallic ſubſtance. In conſequence of this, I re-diſſolved them in water, together with the few reſidual drops of their mother-liquor, and combined them with pruſſiat of pot-aſh (blood-lye). A blue precipitate ſubſided; but in ſo ſmall a quantity, that the *portion of iron*, thus ſeparated, could hardly be eſtimated at one fourth of a grain. The ſupernatant fluid, freed from it, afforded pure ſulphat of alumine to the laſt drop.

m) The cryſtals of alum, obtained in the ſeveral foregoing operations, being dried on a porcelain ſaucer in open air, amounted in the whole to 856 grains. They were then diſſolved in boiling water, decompoſed by carbonat of pot-aſh in the heat of ebullition, and the precipitated earth was edulcorated and dried. But, in order to free this earth perfectly from thoſe ſaline particles, which ſtill adhered obſtinately, and augmented its weight, I ſubjected it to gentle digeſtion, with ſix ounces of diſtilled vinegar. Which done, I neutralized the acetic acid by cauſtic ammoniac; edulcorated afreſh the *aluminous earth*, then precipitated, and laſtly, expoſed it to a briſk red-heat, after drying. It weighed now 98½ grains.

n) It ſtill remained to examine the edulcorating water. Being evaporated to dryneſs, and the reſidue re-diſſolved in little water, there remained a ſlight portion of grey earth, which, when examined by ſulphuric acid, proved to be calcareous. The ſolution yielded, during evaporation, ſelenitic cryſtals; which, when carefully collected, weighed 1½ grain, the *calcareous* earth of which ſhould be eſtimated at one half grain.

What principally demands our conſideration, in the reſult of this analyſis, is the remarkable and unexpected circumſtance of the total abſence of the ſiliceous earth, from among the conſtituent parts of the ſapphire. For the 11¾ grains of ſilex which were obtained (*k*), muſt undoubtedly be aſcribed merely to the flinty triturating veſſel, from which the ſapphire had, on grinding, abraded 12½ grains (*a*), and at the ſame time had united with it ſo intimately, that I could not recover it without great difficulty, and even not without a ſmall loſs of three fourths of a grain.

Hence, the following alone can be reckoned among the conſtituent parts of the ſapphire, procured by decompoſition:

Alumine			98,50
Oxyd of iron	*b*)	½	1,
	e)	¼	
	l)	¼	
Lime	*n*)		0,50
			100.

Since on analyſing foſſils, even with the moſt cautious management, there is always ſome unavoidable loſs, it is probable, that the preſent perfect agreement of the ſum of theſe conſtituent parts, with the original weight of the ſapphire employed, is merely accidental. And the reaſon of this agreement muſt be ſought for, in the variable ſtate of dryneſs, communicated to the aluminous earth by heating it to redneſs.

Whence, ſubtracting the unimportant, and perhaps only caſual portion of calcareous earth, as well as the ſlight quantity of ferruginous matter, we find in the ſapphire, the nature of which is now developed, nothing elſe than a ſimple aggregate of pure aluminous earth.

But, what a high degree of coheſive power, and moſt intimate chemical combination, muſt nature be able to command, in order to be capable of transforming ſuch a common ſubſtance, as the *aluminous earth*, into a body, ſo eminently diſtinguiſhed and ennobled, as we find the *ſapphire* to be, by its hardneſs, denſity, brilliancy, and reſiſtance to the actions of acids and fire, as well as to natural decay in the courſe of all-conſuming time!—It is, therefore, not the *identity*, or preciſe ſameneſs of the conſtituent parts alone, but alſo the *peculiar nature of their chemical combination*, which conſtitutes the *metaphyſical eſſence* of the products formed from them by nature.

V

EXAMINATION

OF THE

CAT'S-EYE.

THE ſpecies of precious ſtones, known by the name c *Cat's-eyes*, has received that denomination from its propert of reflecting, in certain directions, a changeable whitiſ effulgence, in which it reſembles the eyes of a cat.

As this ſtone is ſtill a rarity in Europe, the deſcription c its external characters, met with in the lateſt introduction to Mineralogy, could only be taken from the poliſhed ſpecimens which are brought to us from *Ceylon*. As I hav in my collection rough cat's-eye from the coaſts of *Malabar*, for which I am indebted to the kindneſs of *Franc* *Greville*, Eſq. in London, and which, beſides, is one c its more unuſual varieties, I think the following additio to the deſcriptions of its external characters, already publiſhed, will not be uſeleſs.

The largeſt ſpecimen conſiſts in a fragment, notabl quadrangular, of *one* inch in *length*, three-fourths of a inch in *breadth*, three-fourths ditto in *height*, and three an a half drachms in weight. Its croſs-fracture exhibits brown-red colour of various ſhades, a moderate greaſ luſtre, and minute ſharp-edged prominences. On the longitudinal fracture, its colour is lighter, its luſtre ſtronger, and it reflects variegated yellowiſh rays of light; at the ſame time, that an imperfectly foliated texture, ſpreading in various directions, is perceivable. On two contiguous ſides it ſtill retains its natural ſurface, or cruſt, which is formed lengthways of convex, roundiſh ſtriæ; and its colour, which was at firſt brown-red, has faded into a dull browniſh-yellow. Its edges and ſmall ſplinters alone are faintly tranſparent.

I found the ſpecific gravity of this rough cat's-eye to be 2,625; whereas that of the whitiſh, greeniſh, and yellowiſh ſpecimens from Ceylon is 2,660.

In the *Eſſay on the Habitudes of ſeveral Stones and Earths in ſtrong Fire*, I have already ſhewn that the cat's-eyes are perfectly infuſible in the ſtrongeſt degree of heat produced in the porcelain-furnace; therefore I ſhall at preſent mention only the change which they undergo in a weaker fire. For this purpoſe I ignited to redneſs in a crucible ſome of the common poliſhed cat's-eyes, of a greeniſh and greyiſh-white colour, and quenched them in cold water. I found them afterwards abſolutely unaltered in form, hardneſs, and ſplendour; but they were rendered totally opake, and acquired an extremely fine marbled jaſper-like appearance, variegated with brown, reddiſh, grey, and white ſpots.

A.

a) *Two hundred* grains of finely levigated *Cat's-eyes from Ceylon*, were mingled with 400 grains of carbonat of ſoda

(mild

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[illegible] with carbonated ſoda ;
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[illegible] ignition amounted

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[illegible] added to the ſolu
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[illegible] one half grain, w

precipitated by carbonat of ſoda. This alumine, when edulcorated, and ignited after deſiccation, was found to weigh 3½ grains.

f) The liquor which remained, after the precipitation had been effected by cauſtic ammoniac (*d*), was then combined in a warm temperature with mild mineral alkali; by which treatment, *calcareous earth* ſubſided, which formed ſelenite (ſulphat of lime) with ſulphuric acid. The lime thus ſeparated from this compound, and ignited, weighed three grains.

Since, therefore, 200 grains of theſe cat's-eyes afforded

Silex	*a*)	189	190
	b)	1	
Alumine	*e*)		3½
Lime	*f*)		3
Oxyd of iron	*d*)		½
			197 grs.

it follows, that it contains in *one hundred*,

Silex	95
Alumine	1,75
Lime	1,50
Oxyd of iron	0,25
	98,50
Loſs	1,50
	100

Therefore, this *proportion of the conſtituent part*
in both varieties is to be conſidered as perfectly
together with their *abſolute infuſibility*, (not to me
difference in the external character) afford ſufficie
for diſtinguiſhing *cat's-eye* from *fel-ſpar*, under w
foſſil has been claſſed by ſeveral Mineralogiſts.—
contrary, it would be more proper, in my opinion,
it with the opals; among which alſo it was forme
oned under the names of *Pſeudopal*, *Cat's-eye-opal*.

VI.

ANALYSIS

OF

CHRYSOBERYL.

THE *Chryſoberyl*, found in the Braſil, paſſed for a variety of the Chryſolite, until M. *Werner*, Counſellor of the mines, was induced, by a more accurate compariſon of their reſpective external characters, to ſeparate the former from the latter; and to range it in the mineralogical ſyſtem as a diſtinct ſpecies, with its preſent denomination. This Chryſoberyl, however, muſt not be miſtaken for the *Chryſoberyl of the ancients*, which really was the ſubſtance indicated by this name; that is to ſay, the *golden-yellow beryl*; as may be concluded from its deſcription, given by *Pliny*. Libr. XXXVII. Cap. V. *Probatiſſimi ſunt ex iis*, (namely Beryllis), *qui viriditatem puri maris imitantur. Proximi, qui vocantur* Chryſoberylli, *et ſunt paulo pallidiores, ſed in aureum colorem exeunte fulgore.*

The modern chryſoberyl has hitherto been met with only in ſhivery, looſe, rounded grains *, of the ſize of ſmal-

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* *Geſchiebe* in German. *Rachill* by the miners; or ſuch looſe, ſmall, ſhivery ſtones, as moſt commonly lie on the top of the rock, or immediately under the vegetable earth. See *Hooſon's Miner's Dictionary*.—Tranſl.

ler and larger peas, of a pale-yellow colour, inſe
verging to green. The ſurface of theſe grains, wh
ſomewhat rough, ſtrongly glitters, and uſually r
variegated colours, like moonſtone (adularia). B
fracture of chryſoberyl poſſeſſes a great ſplendour, v
in conjunction with a very conſiderable hardneſs, gi
a high brilliance when poliſhed: and hence it may
be confounded with the yellow diamond. Some fe
cimens exhibit ſome remaining traces of an orig
cryſtalline figure.

The ſpecific gravity of this ſtone I have found
3,710; which therefore agrees with that mention
Werner, from 3,698 to 3,719, and is preciſely the
between theſe two extremes.

The firſt analytical attempts upon it, which I made
I was acquainted with thoſe ſkilful proceſſes wh
learned from later experiments, gave me a good d
trouble, and at the ſame time deſtroyed a conſiderabl
of my ſtock of theſe ſtones. But I paſs them ove
confine myſelf merely to that analyſis, the reſult of
was the complete decompoſition of the chryſoberyl.

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a) *Hundred grains* of chryſoberyl, previouſly r
to a moderately fine powder, by pounding them in a
tar of poliſhed ſteel, were levigated with water to
fineneſs in the flint grinding-diſh. After the powd
become dry, I ſubjected it to gentle ignition, for th
poſe of freeing it from all moiſture. However, its
was increaſed 13 grains.

b) Upon theſe 113 grains, introduced into a ſilve
cible, I poured ſo much cauſtic lixivium, that the prop

of alkali which it contained amounted to 800 grains, and evaporated the liquid again till the maſs was dry. Upon this I placed the crucible with its contents in a wind-furnace, on a ſtand of porcelain clay, ſurrounding it with coals. Attention was carefully paid to prevent the maſs, which greatly ſwelled in bulk, from flowing over the veſſel. The heat applied was at firſt rather low; but it was gradually urged until the maſs became red-hot. In this degree of heat it was kept for two hours; but it did not enter into actual fuſion.

c) When this maſs had cooled in ſome degree, I ſoftened it in the crucible with water, and poured the ſolution upon the filter. When the fluid parts had paſſed through, there remained on the paper a looſe, light-grey powder, which, when edulcorated and dried, weighed 66½ grains.

d) The alkaline lye that had been ſeparated, together with the edulcorating water, was firſt evaporated, to leſſen its bulk, and then ſaturated with muriatic acid. An abundant white precipitate fell down, but was inſtantly and clearly re-diſſolved, by a ſmall exceſs of acid. Carbonat of pot-aſh, added over a low fire, again precipitated this earth; which being waſhed, and dried in a gentle warmth, was looſe, as white as ſnow, and weighed 138½ grains.

e) The light-grey pulverulent reſidue, mentioned at (*c*), amounting to 66½ grains, being digeſted with muriatic acid, left again a reſidue; which, after waſhing, drying, and ignition, weighed 24½ grains, and was found, upon farther examination, to be pure *ſiliceous earth*.

f) This muriatic ſolution (*e*), ſeparated from the ſilex, was next decompoſed, in a boiling heat, by means of cauſtic ammoniac, and the yellowiſh precipitate, thus produced, was edulcorated; and, while yet moiſt, was boiled with cauſtic lye. It entirely diſſolved therein, ſome brown particles excepted. This reſidue was *oxyd of iron*, an weighed, after ignition in a gentle heat, 1½ grain.

g) The alkaline ſolution (*f*) was ſaturated with muriatic acid. The reſult of this proceſs was a white precipitate, which, by a ſlight ſuperſaturation, again formed limpid ſolution. The earth was then a ſecond time precipitated, by boiling with mild vegetable alkali. Its weigh amounted, after deſiccation, to 29 grains.

h) Theſe laſt 29 grains, together with the precedin 138½ grains of earth (*d*), to which I alſo added the tw grains, which were collected from the edulcorating wate by evaporation, were digeſted with diluted ſulphuric acid The whole was diſſolved, excepting ſome *ſiliceous earth* which weighed 4 grains after ignition.

i) When this ſolution, now perfectly clear, was a littl evaporated at a low temperature, tender, ſpicular, or ſpear-ſhaped cryſtals, gradually ſeparated from it; which I collected with proper care. They preſented all the marks o ſelenite; and, on decompoſition by a ſolution of carbonat of pot-aſh, in boiling heat, they afforded 11 grains c mild *calcareous earth* (carbonat of lime). This calcareo conſtituent part of the chryſoberyl was, doubtleſs, befo contained in the precipitate of (*d*); and, previous to it sfallin down, it was held in ſolution merely by the water, as was then in the cauſtic ſtate.

k) This ſulphuric ſolution I now combined with t proportion of carbonated pot-aſh requiſite to the formatic of alum*; which ſhot, by degrees, into regular cryſtal

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* On the neceſſity of pot-aſh, and its proportion in the formati of alum, ſee *Hildebrandt's paper* in *Nicholſon's Journal*, vol. I page 49.—Tranſl.

Towards the end, however, a ſlight portion of *ſiliceous earth* appeared, which, after ignition, was not more than 2½ grains. The weight of all the ſulphat of alumine obtained amounted to 604 grains.

l) This alum was again re-diſſolved in boiling water, and afterwards decompoſed by means of carbonat of potaſh, at the heat of ebullition. After the precipitated earth had been waſhed, dried, and gently ignited, I digeſted it with diſtilled vinegar; which being neutralized by cauſtic ammoniac, the earth was again precipitated by this treatment, and again waſhed, deſiccated, and heated to redneſs. It proved now to be perfectly pure *aluminous earth*, weighing 71½ grains.

We may, therefore, infer, that the conſtituent parts of the chryſoberyl, exhibited by this analyſis, conſiſt in the *hundred*, of

Alumine	*l*)		71,50
Lime	*i*)		6
Oxyd of iron	*f*)		1,50
Silex	*e*)	24½	
	h)	4	
	k)	2½	
		31	
To be ſubtracted	*a*)	13	
Remain		18	18,00
			97
Loſs			3
			100

From comparing the preſent analyſis of *chryſoberyl* wi the following decompoſition of *chryſolite*, it is evident ho greatly their reſpective conſtituent parts differ, and con ſequently, how neceſſary it was to ſeparate them from eac other, in the ſyſtematical arrangement of the ſpecies o gems.

VII.

EXAMINATION

OF

CHRYSOLITE.

THE *Chryſolite* affords a ſingular inſtance of change in names; ſince, at preſent, we call the ſame gem *Topaz*, which the ancients underſtood by the denomination *Chryſolite*; for it is evident, from the following words of Pliny, that the *Topazius* of the ancients is not our modern Topaz; but, on the contrary, the Chryſolite of the preſent times: *Ejus tota ſimilitudo ad porri ſuccum dirigitur. Eſt autem ampliſſima gemmarum. Eadem ſola nobilium limam ſentit: cætera Naxiis cotibus poliuntur. Haec et uſu atteritur.* *Pliny* Hiſt. Nat. Lib. XXXVII. Cap. VIII.—The cauſe of this change of name is ſo much the more unaccountable, as the denomination Chryſolithus (golden-ſtone) undoubtedly more applies to the Topaz, which is of a golden-yellow colour, than to our Chryſolite, which is green.

The more detailed external deſcription of the *Chryſolite*, given by *Werner*[*] with that degree of accuracy we are en-

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[*] *Bergmänniſches Journal*, 3d *year*, 1790, *Vol.* 2, *page* 54.

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Hawkins, Eſq. in the
the knowledge of
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gravity of Chryſolites I
ſtatement of *Werner*, namely,

nited it afterwards for thirty minutes. There remained a friable maſs, which, after cooling, was of a duſky olive-green.

b) When this maſs had been ſoftened with water, the ſolution aſſumed the ſame colour, and a brown, undiſſolved portion fell to the bottom, of a ſlimy appearance. The ſolution being ſaturated to exceſs with muriatic acid, and ſufficiently digeſted, acquired a ſaffron-yellow colour: upon which it was diluted with water, and filtered. A pure ſiliceous earth then remained, which, after ignition, amounted to 72½ grains.

c) The muriatic ſolution, when decompoſed in a boiling ſtate by mild vegetable alkali, prepared from tartar, afforded an abundant, light-brown-red precipitate, which, upon deſiccation, again entirely diſſolved in muriatic acid, and by the affuſion of cauſtic ammoniac, formed a brown-red precipitate; which was directly ſeparated by filtering, then waſhed, and digeſted with cauſtic lye, while yet moiſt. However, only a ſmall portion ſeemed to diſſolve by this treatment.

d) After the undiſſolved matter had been ſeparated from the alkaline ſolution (*b*), I ſuper-ſaturated this laſt with muriatic acid, and added carbonated pot-aſh, for the purpoſe of obtaining a precipitate. However, only a little earth ſeparated, which, when collected, and tried for alumine by ſulphuric acid, did not diſſolve in it; but, on cloſer examination, proved to be *ſiliceous earth*, weighing 3½ grains after ignition.

e) The brown precipitate, which had been digeſted with cauſtic lixivium (*c*), when dry and expoſed to a red-heat, gave 38 grains in weight. It conſiſted of a pure *oxyd of iron.*

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iron. The whole was attracted by the magnet. Upon being diſſolved in muriatic acid, and again precipitated by pruſſiat of pot-aſh, it yielded 88 grains of very deep coloured Pruſſian-blue.

f) The muriated fluid, after the ferruginous contents had been ſeparated from it by ammoniac (*e*), gave a copious white and looſe earth, by adding carbonat of pot-aſh. The mixture having been kept boiling for ſome time, this earth was ſeparated by filtration, well waſhed, and dried. It amounted to 198 grains of *carbonated magneſia* (mild magneſian earth), which I divided into two parts. One half of it was ſtrongly ignited for the ſpace of an hour, and left 39½ grains, which produced a briſk ebullition upon the affuſion of ſulphuric acid. The other half was introduced into dilute ſulphuric acid. It directly afforded a clear ſolution and pure ſulphat of magneſia (Epſom ſalt), by cryſtallization.

Note. It was by mere accident that, on the precipitation at (*e*) no more ammoniac had been added than was juſt neceſſary to ſeparate the oxyd of iron; ſince otherwiſe, in all caſes, the magneſian earth is alſo precipitated by ammoniac.

According to this decompoſition, the conſtituent parts of the chryſolite ſhould be in the *hundred*,

Ignited *Silex*	*b*)	36¼	38
	d)	1¾	
Ignited *Oxyd of Iron*	*e*)		19
Ignited *Magneſia*	*f*)		39,50
			96,50
		Loſs	3,50
			100

B.

a ſecond analyſis of chryſolite I choſe poliſhed ſpe- which, beſides a pure tranſparency, poſſeſſed alſo er colour: whereas the crude chryſolites, employed oregoing proceſs, were in ſome parts inclining to As I intended, at the ſame time, to learn whe- ids alone were capable of decompoſing this ſtone, : previous treatment with alkali, I made uſe ſulphuric acid, according to the manner in which *raf* has employed it for decompoſing the ſerpentine.

poured ten drachms of concentrated ſulphuric acid, vith double that quantity of water, upon *two hundred* of moſt finely-powdered chryſolite, placed in a re- d abſtracted again the fluid, in a moderate diſtilling til the remainder in the retort appeared a dry maſs. quor which came over, emitted a moderate ſul- s ſmell. When cold, I collected the maſs from the the upper part of which I cut off, and lixiviated boiling water. The ſolution exhibited a greeniſh- but ſo faint as to be hardly perceptible.

he undiſſolved reſidue was boiled a ſecond time, in ſs, with two drachms of concentrated ſulphuric acid, o ounces of water. After this it was again col- on the filter, waſhed with an abundance of water, deſiccated, and heated to redneſs. It to be pure, white *ſiliceous earth*, weighing 78

Both the ſulphuric ſolutions (*a*) and (*b*) were eva- d to dryneſs in a porcelain-ſaucer. The reſidual ad a greeniſh-grey tinge: it was firſt gently heated in

[illegible]
[illegible] it contain
[illegible] to ignition.
[illegible] the preſent ſta
[illegible] of oxygen t
[illegible] the chryſolite, in
[illegible] in melted
[illegible] wax had been bur
[illegible] in a low red
[illegible] red colour had
[illegible] it was alſo readily
[illegible] grains.

[illegible] colourleſs ſulphated ſolut
[illegible] cryſtallization, it yielded,
[illegible] magneſia. This neutra
[illegible] in the heat of
[illegible] 213 grains of
[illegible] weight of which, aft
[illegible] grains.

Note. The reaſon why, in the preſent decompoſition, there is a ſlight exceſs of weight in the ſum of the conſtituent parts, inſtead of the uſual loſs in moſt other caſes, undoubtedly depends in the variable degrees of dryneſs which thoſe ingredients acquire on ignition.

In the quarries near *Leutſchau*, in Hungary, we meet with a pale-green ſerpentine, mixed with grey, and croſſed by tender veins of aſbeſtus. It alſo contains, copiouſly diſſeminated, reſplendent grains, of a high green colour, which, in ſome parts of my ſpecimen, exhibit a rhomboid cryſtallization. *Born* * and *Fichtel* †, who have given a more circumſtantial information reſpecting this ſtone, call theſe grains *Chryſolite*. *Fichtel*, however, is uncertain whether they ſhould not rather be conſidered as Chryſopraſe. But this conjecture is too little favoured by the external characteriſtic marks; while, on the other hand, the minuteneſs of theſe grains, and the impoſſibility of ſeparating them from the ſtone, which ſerves them for a matrix, will not admit of a chemical examination. Notwithſtanding this, their preſence in the ſerpentine affords a *geognoſtic* argument for conſidering them as chryſolite, ſince the conſtituent parts of each have been diſcovered to be the ſame.

* * *

A looſe ſtony matter (*rachill*), which is found near *Moldauthein*, in Bohemia, has likewiſe, for ſome time paſt, been held out to be chryſolite: but, on judging from the to agree with m

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* Catal. meth. et raiſon, de la collect. des Foſs. Tom. I. p. 69.

† *Mineralog. Bemerk.* v. d. *Karpathen*, I. Th. Wien. 1791, page 60, 61.

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* See his *Beitrag zur* Geſchichte der bö
in den Saml. phyſikal. Aufſätze beſonders
ſchichte betreffend. 2 *Band Dreſden*, 1792.

VIII.

EXAMINATION

OF

OLIVIN.

To the various ſtones which were formerly conſidered as a ſubordinate ſpecies, or rather variety of chryſolite, alſo belongs the foſſil known by the name of *Baſaltic*, or *Volcanic Chryſolite.*

On giving the external deſcription of this ſtone, together with that of the true chryſolite, *Werner* has not only accompanied it with the moſt inſtructive obſervations, but likewiſe, from his *oryctognoſtic* inquiries, he has ſhewn the neceſſity of diſtinguiſhing the *baſaltic* from *true* chryſolite. Whence alſo he conſiders the former as a diſtinct ſpecies, with the name *Olivin*, taken from its colour.

As it is the office of Chemiſtry to aſſiſt the *Oryctognoſtic Science* * in the further improvement of its ſyſtem, by

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* By *Oryctognoſy*, *Werner* underſtands the *ſcientific* knowledge or diſcrimination of foſſils from each other, conſidered as ſimple, that is, not compounded aggregates of various different minerals; and their *ſcientific* arrangement, or *claſſification*, into a regular ſyſtem, according to certain *orders*, *claſſes*, *genera*, *ſpecies*, *varieties*, &c.—Tranſl.

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It aſſumed a grey colour, and was then liquefied or ſoftened with water, and filtered.

b) Upon ſaturation with muriatic acid, the alkaline lixivium let fall a white earth, which, being collected and dried, was boiled with ſulphuric acid. But this earth did not impart any foreign taſte to the acid; and when this laſt had again been decanted off, and ſaturated with mild alkali, it continued clear. Therefore the above earth was of the pure *ſiliceous* kind. When ignited, it weighed 49 grains.

c) The aſh-grey reſidue, ſepatated from the alkaline lye (*a*), coagulated to a thickiſh brown maſs, upon the affuſion of muriatic acid. After this coagulum had been diluted and digeſted with ſufficient water, there remained a copious, light, ſlimy, and brown reſidue, which, upon deſiccation, weighed 152 grains.

d) The muriatic ſolution, ſeparated from this reſidue by filtration, was colourleſs. By the addition of mild alkali, prepared from tartar, it was decompoſed with the aſſiſtance of boiling heat, and 181 grains of a very white, looſe earth, were precipitated.

e) When the brown reſidue, mentioned at (*c*), after trituration, was digeſted with muriatic acid, it diſſolved into a yellow liquid, leaving, at laſt, *ſiliceous earth* behind, weighing 43 grains after ignition.

Note. It was undoubtedly this ſiliceous earth, ſtill intimately united with the ferruginous part of the ſtone, which in (*c*) prevented the muriatic acid from exerting its action on the oxyd of iron: yet this circumſtance, at the ſame time, furniſhed the means of exhibiting, free from iron, that portion of the earth which the acid had diſſolved.

f) The ferruginous portion of the yellow muriati ſolution (*e*) I precipitated by cauſtic ammoniac. It wa then collected and waſhed; and, while yet moiſt, boiled wit cauſtic lye. The lixivium was then again ſeparated b filtration, combined with muriatic acid to ſuper-ſaturatio and afterwards precipitated by carbonated alkali. Only ſmall portion of earth fell down, which, upon trial, prove to be *ſiliceous*, and weighed 4 grains, after it had been e poſed to a red-heat. The liquor remaining, after the pre cipitation of the iron, was mixed with carbonat of pot-aſh but no further precipitation nor turbidneſs enſued.

g) The *oxyd of iron*, that was again collected after t boiling with muriatic acid (*f*), was put into melted wa in a ſmall crucible, and heated to redneſs; after th laſt had been burned off, it obeyed the magnet, an amounted to 25 grains.

h) Upon the above 181 grains of earth (*d*) I poure dilute ſulphuric acid; in which it diſſolved with efferve cence. When the ſolution had been reduced within ſmaller compaſs by evaporation, it depoſited minute ſpicul cryſtals, conſiſting of 1½ grain of ſelenite, the pure *ca careous earth* of which is to be eſtimated at ½ grain.

i) The ſolution, on further evaporation, yielded pu ſulphat of magneſia; which, being re-diſſolved, and p cipitated at the temperature of boiling, by carbonat of p aſh, depoſited a very pure and looſe *magneſian earth*, wh weight, after ignition for an hour, amounted to grains.

It follows, from theſe operations, that the conſtitue parts of the Olivin from Unkel are, in the *hundred*,

Ignited *Silex* . . .	*b*)	24½	
	e)	21½	: . 48
	f)	2	
Magneſia . .	*i*)	. . . .	37
Lime	*h*)	. . . . . .	0,25
Ignited *Oxyd of Iron* .	*g*)	. . . .	12,50
			97,75
		Loſs .	2,25
			100

B.

With the view of confirming theſe reſults, I undertook another decompoſition of the ſame *Olivin from Unkel.* In this inſtance I treated it immediately with ſulphuric acid, in the ſame manner as I did with the chryſolite, without previous ignition, in conjunction with alkali.

a) I put *two hundred* grains of moſt finely pulverized olivin in a retort, pouring upon them *ten* drachms of ſulphuric acid, together with a ſufficient quantity of water; and again diſtilled the liquid over to dryneſs. Upon this I ſoftened the remaining grey-white maſs with hot water, and boiled afreſh the undiſſolved earth, ſeparated from the fluid, with 2 drachms of ſulphuric acid, and ſufficient water. The liquid, filtered off from the reſidue there left, was added to the firſt ſolution. What remained was mere *ſiliceous earth*, whoſe weight, after ignition, amounted exactly to 100 grains.

b) The ſulphuric ſolution (*a*) left, upon evaporation, a greyiſh-olive-green ſaline maſs, which I evaporated ſtill farther in a porcelain-crucible, urging it at laſt to a red-heat in ſtronger fire. The maſs retained at firſt its whitiſh colour but at length it aſſumed a pulverulent ſtate, and turne brick-red. When triturated, drenched with hot water, an filtered, it left a red *oxyd of iron*, which, after being treate with wax and ignited, weighed 24 grains.

c) After the clear ſolution of (*b*) had been evaporated i order to cryſtallize, it ſhot wholly into ſulphat of magneſia but, when it was re-diſſolved in a moderate proportion o water, ſome cryſtals of ſulphated lime appeared, the quantity of which indicated one half grain of pure *calcareou earth*. Theſe laſt having been ſeparated, the remaining ſolution was decompoſed, by means of carbonated pot-aſh, i boiling heat. The *magneſian earth*, thus obtained, was pure white, and looſe. When deſiccated at a ſomewhat raiſe temperature, its weight amounted to 188½ grains; but it wa reduced to only 77 grains, by ignition for the ſpace of a hour.

By this method of analyſing, which, with regard to magneſian ſtones, is not only the moſt commodious, but al indicates the reſults with the greateſt exactneſs, the conſtituent parts of the *Olivin from Unkel* were found to be, i the *hundred*, as follows:

Silex . . .	*a*)	50
Oxyd of Iron .	*b*)	12
Magneſia	*c*)	38,50
Lime . . .	*c*)	0,25
		100,75

Note. The ſame obſervation applies to the agreement of this ſum with the weight of the ſubſtance employed, and the ſlight exceſs, as has been already mentioned, at the end of the ſecond analyſis of chryſolite.

SECOND SECTION.

Analyſis of the Olivin from Karlsberg.

The Olivin from the Baſalt of *Unkel*, employed in the foregoing examination, was, as has been mentioned, in its freſh and unimpaired ſtate: but as moſt olivins ſhew more or leſs evident marks of decay, it ſtill remained to enquire, whether, in thoſe ſpecies of olivin that are more diſpoſed to decay, any difference exiſted in their conſtituent parts. For this inveſtigation I choſe the *olivin* from the Baſalts of the *Karlsberg*, near *Caſſel*, in *Heſſia*. I comminuted it coarſely, and waſhed off with water the yellow iron-ochre that inveſted its ſurface and its chinks. It then conſiſted, for the moſt part, of ſmaller grains of a faint greeniſh-yellow colour, but in part alſo of larger grains, whoſe colour was a ſomewhat freſher leek-green. In theſe latter I obſerved black-grey particles, of a metallic luſtre, imbedded in, or concreted with, their ſubſtance. When I had ſtrongly ignited ſome of theſe upon charcoal, I found that the green ſtony matter of the olivin had thereby become grey, dull, and opake; while the diſſeminated black-grey particles had ſuffered no change. This ſhewed, that they were not minute cryſtals of horn-blende, but iron, and eſpecially of the nature of the ſpecular, or grey iron-ore, becauſe they were not attracted by the magnet.

a) Upon *three hundred* grains of this olivin, finel verized, I poured 4 ounces of ſtrong ſulphuric acid, to with 2 ounces of water, and again diſtilled from i fluid, which emitted a ſlight ſmell reſembling ſulphu acid, until the reſidue became a dry maſs. The *ſil earth*, remaining after this maſs had been boiled witl ter, was a ſecond time boiled with half an ounce o phuric acid, and ſufficient water. After this it was lected and ignited. It weighed 156 grains.

b) In order to learn whether *aluminous earth* was o the extracted conſtituent parts, I took the third part o whole of the ſulphuric ſolution, and precipitated, by bonated pot-aſh, at the degree of ebullition, all that it in ſolution. The freſh precipitate had a dirty, b colour; and I put it into cauſtic lixivium, as ſoon as it edulcorated, digeſting it with the lye for ſome time. mixture was next diluted with more water; the lye, rated from it by filtering, was ſaturated with muriatic a and, after a ſlight ſuper-ſaturation, again combined with al But this produced neither a precipitate nor muddineſs.

c) Being thus convinced of the total abſence of al nous earth, I evaporated the remaining two-thirds o ſulphuric ſolution (*b*) to a dry ſaline maſs, which I exp to a ſtrong red-heat in a crucible, for the purpoſe of compoſing the ſulphat of iron which it contained. I re-diſſolved the ignited maſs in water, and ſeparated th *oxyd of iron* by filtration; which, by ignition with was rendered attractible by the magnet, and weighe that condition, 21½ grains.

d) The ſolution, freed from the oxyd (*c*), cryſtallize degrees into ſulphat of magneſia. When this had again l diſſolved in a ſmall quantity of water, light, delic

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needled cryſtals of ſelenite were left, the quantity of which hardly amounted to ¾ of one grain, which indicates ¼ grain of pure *calcareous earth.* To the diſſolved ſulphat of magneſia, corbonat of pot-aſh was added in a boiling heat; and thus its *magneſian earth was precipitated*, amounting, after ignition, to 75½ grains.

Whence the conſtituent parts of the *Heſſian* olivin, and their reciprocal proportions in the ignited ſtate, conſiſt, in the *hundred*, of

Silex	*a*)	52
Magneſia	*d*)	37,75
Oxyd of Iron	*c*)	10,75
Lime	*d*)	0,12
		100,62

* * *

From theſe reſults, it is plain that the olivin and chryſolite are very nearly related to each other; and, as the conſtituent parts of each other are ſo much the ſame, and their reſpective proportions not too diſſimilar, it ſeems to me proper that theſe two ſtones ſhould no longer be divided into two different ſpecies; but that the difference, deduced from their external characters, can only juſtify the ſubdividing them into two *varieties* of *one ſpecies.* Moreover, ſince no greater difference appears to take place between them, than, perhaps, that by which the baſaltic horn-blende is diſtinguiſhed from the common, it follows, that the olivin might be entitled to claim its former denomination of *baſaltic chryſolite.*

According to the habitudes of the chryſolite and olivin in the heat of the porcelain-furnace, (mentioned in the firſt Eſſay, n. 25, and 61-64), the former returned fro fire unaltered in form; but the ſecond appeared in con grains, which were cemented together by the heat more or leſs force of adheſion. From this circum I was induced to repeat the experiment with the chryſ with this difference, however, that I broke it into pie the ſize of the grains of olivin, before I incloſed it i charcoal. After thoſe pieces had undergone the acti the fire, I found them, like ignited olivin, of an iron-colour, opake, thinly glazed, and conglutinated. Yet the glazing and concretion were ſomewhat leſs i gree than what took place in the *Heſſian* and *Gree* olivins.

IX.

CHEMICAL EXAMINATION

OF VARIOUS

SILVER-ORES[*].

AT the time when Philoſophical Chemiſtry was yet in its infancy, and when it was not known how to decompoſe natural bodies otherwiſe than by fire, with very few exceptions, the knowledge of the conſtituent parts of the bodies, belonging to the mineral kingdom, could not but be imperfect. Chemiſts were ſatisfied with the products obtained in the dry way, as it is called, and either paid no attention at all to the other ſubſtances contained in theſe bonies, or, confiding in groundleſs hypotheſes, have fancied certain conſtituent parts, of which nothing could be diſcovered by the light kindled by Philoſophical Chemiſtry, the baſis of which is real facts.

Only, while this latter was advancing in its progreſs, the learned began to perceive, and ſeriouſly to attend to this great deficiency of knowledge reſpecting the foſſil kingdom, as well as to the tottering foundation of the mineralo-

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[*] Read in the Royal Acad. of Scienc. at Berlin.—See the *Collect. of Germ. Treatiſes* of that Acad. Berlin, 1793 and 1794.

Yet, all that has hitherto been don
nothing more than a ſplendid beginni
ance with the conſtituent parts of ſuffi
within narrow limits. Not only are w
the compoſition of a multitude of ſuffi
reſpect to thoſe, with which we appear to be
further confirmation is required: for
detrimental to the progreſs of a ſcience,
rors as undoubted and long-eſtabliſhed tr
them from one ſyſtem, and from one ele
into another, and to multiply them by c
muſt be as groundleſs as the premiſes, from
inferred, are falſe.

If, therefore, a ſyſtematical mineralogy, ar
ing to the chemical conſtituent parts, (whic
hardly been eſtabliſhed), is to be ſupported b
foundation, and brought nearer to

Among the numerous productions of the foſſil kingdom, of which an exact chemical knowledge is yet wanting, the *genus of the ſilver-ores* ſeemed to me to require, in a high degree, a re-examination and amendment. For this reaſon I have ſubjected its chief ſpecies to analytical treatment; the reſults of which are communicated in the following ſections.

FIRST SECTION.

Native Hornſilver, or Corneous Silver-ore. (Hornerz).

(*Vitriolico-muriated Silver-ore*, by *Kirwan.*)

THE *Corneous* is remarkable among the rarer *ores of ſilver*, not only from its richneſs, but alſo from the ſubſtance by which nature has mineralized that noble metal.

The name *Hornerz* appears to be of a later date than our knowledge of that ore, ſince ſeveral writers on metallurgy, of the 16th century, have already mentioned it with the appellation of *Glaſerz*; for it is obvious, from the deſcriptions which thoſe authors have given of it, that they did not mean our modern *Glaſerz*, namely, the ſulphurated ſilver-ore. *Mattheſius**, noticing ſeveral of its varieties, calls them *white*, *grey*, *yellow*, *green glaſerz*; and ſays, "*it is tranſparent like horn in a lanthorn, and fuſes in the flame of a candle.*"—*Fabricius*† mentions a liver-coloured ſilver-ore, "*which in lumps, viewed againſt the light, is obſcurely*

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* *Mattheſius* Sarept. 1585. Norimb.

† *Fabricius* de rebus metall. Zürch, 1566.

tranſparent like horn, and in ſmall parts is entirely tra parent like ice."—From this it may reaſonably be co jectured, that the *glaſerz* of the ancients has, in later tim been erroneouſly confounded with our modern one, as th denomination is, indeed, more ſuiting the *hornerz*, or co neous ſilver-ore, than ſilver, mineralized by ſulphur; an on the other hand, no reaſon can be found for giving th name to the latter.

During the 16th century, in which the Saxon and B hemian mines yielded vaſt treaſures, the revenues ariſi from this ſilver-ore often amounted to ſeveral hundr marks (8 ounces each): but, in the progreſs of time, it b came ſcarcer and leſs known, until the celebrated Saxo maſter of the mines, Mr. *Pabſt of Ohain*, diſcovered i as it were, anew, and gave it the name *Hornerz*, becau reſembling the factitious *horn-ſilver* (muriat of ſilver.)

It occurred formerly at *Joachimsthal*, *Annaberg*, *Schne berg*, *Freiberg*, and in greateſt quantities at *Johan Georgenſtadt*. At preſent, it is alſo found in ſome mines the *Altaic mountains* in Siberia; and, according to *Sag* likewiſe in the province of *Guamanga* in *Peru*, togeth with the native ſilver.

With reſpect to external form, I have met with the fo lowing varieties of the corneous ſilver-ore.

1) *Maſſive (Derbe)*. As ſuch it has been worked, in t times of its abundance, in the above-mentioned Bohemian a Saxon mines, copiouſly, and ſometimes in pieces of upwards an hundred marks in weight. There may yet be ſeen, in t electoral-mineral cabinet, at *Dreſden*, a piece of that kind, c in a cubical form, weighing ſeveral pounds; and alſo a ſmal

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one, which has ſome impreſſions of ſtamps. Both theſe ores are probably remnants of that century, which have been fortunately ſaved. The colour of this corneous-ore is a dirty brown, though its proper hue ſeems to be the pearl-grey, and the brown tinge to ariſe from the interſperſed iron-ochre. It is ſoft; and may, like wax, be cut with the knife into thin chips; is poſſeſſed of a waxen gloſs, and tranſparent on the edges and thin places.

2) In *lamellar pieces (ſchaalig)*, incumbent on meager quarz, in the form of a cruſt; from the *Schlangenberge.*

3) In ſtill thinner layers, in part only incruſting, (*angeflogen*, or lying ſuperficially), at times accompanied by native gold, or alſo by *lead-ſpar*, or ſpathoſe lead-ore, from the ſame place.

4) *Cryſtallized* in minute regular cubes, of a pearl-grey colour; from *Johann-Georgenſtadt.*

5) In fine *ſcales*, or *flakes*, of a whitiſh colour. In this manner the corneous ſilver-ore, even now, ſometimes occurs at *Johann-Georgenſtadt*, upon brown iron-ochre (*Eiſen bräune*).

6) In an *earthy* form, mingled with argil. This is the genuine *butter-milch ſilver* (argillo-muriated ſilver-ore) of the former mineralogiſts, and which *Veltheim** has deſcribed. The ſpecimen which I have ſeen was dug up in the year 1617, on the old St. *George* mountain, at *Andreaſberg*, and is now preſerved at Berlin, in the royal department of the

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* *Crell's* German edition of *Kirwan's* Mineralogy. Berlin, 1765, page 281, ſeqq. in the notes.

mines. It conſiſts of an aëtitic, kidney-formed nodule calcareous ſpar, the cavity of which is filled with t butter-milch ſilver, in the form of a deſiccated earth, ternally of a ſlate-blue, but of a browniſh white on recent fracture; with which ore, likewiſe, the outer ſu of the ſpecimen are for the moſt part coated.

7) In grey lime-ſtone, but *imperceptible* to the eye; fr *Annaberg*, in Lower Auſtria. This laſt is the foſſil m tioned by *Juſti* *, under the name of *alkaline ſilver-ore.*

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The following are the principal chemical reſearches t have been made into the corneous ſilver-ore, as well as eſſential ingredients, and are communicated to the ſcienti public:

1) That of *Lommer* †, maſter of the mines in Saxo who has alſo given the beſt information reſpecting history and external properties of this mineral. This thor eſtimates the argentine portion of this ore, when pure ſtate, at 28 *per cent.*; but the violet-ore of this kind ſuppoſes to contain alſo a portion of alkalized ſulphur.

2) *Woulfe* ‡ is of opinion, that he has diſcovered, in t corneous ſilver-ore, beſides the muriatic acid, the ſulphuri as a mineralizing medium. It is upon the authority of t ſtatement of *Woulfe* that *Kirwan*, *Bergmann*, and oth *mineralogiſts*, aſſert, that the ſilver is mineralized in the co

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* *Juſti, Chemiſche Schriften.* I. Th.

† *Abhandl. vom.* Hornerz, von *Lommer*. Leipzig, 1776.

‡ *Experiments* on the mixture of ſome minerals.

neous-ore by the ſulphuric as well as by the muriatic acid.

3. *Sage*[*], of *Paris*, has examined the corneous ſilver-ore from Peru; and ſtates the *maximum* contained of ſilver, in the *hundred*, to be from 70 to 74. He adds, that the metal is mineralized by muriatic acid; and, beſides, combined with a peculiar fattiſh matter.

4) *Laxmann*[†], of *Peterſburg*, on the contrary, maintains, that no muriatic acid is contained either in the Siberian or Saxon corneous ſilver-ore; and that in it the metal is mineralized by ſulphur, in the ſame manner as in the glaſerz, viz. the vitreous or ſulphurated ſilver-ore.

On conſidering this diſcordance among the learned, reſpecting the nature of the ſubſtance which mineralizes the ſilver in the corneous-ore, I think that it will not be ſuperfluous if, to the enquiries of theſe chemiſts, I add the experiments which I had the opportunity of making with ſeveral varieties of this ſilver-ore.

A.

The above-mentioned *maſſive corneous ſilver-ore*, from the larger ſpecimen in the Electoral collection at Dreſden, was the principal ſubject of my analyſis, a ſufficient quantity of it having been given me for that purpoſe with the greateſt liberality.

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[*] Analyſe Chim. et. concord. des trois regnes. Paris, 1786.

[†] Nov. Comment. Acad. Scient. Petrop. 1774.

a) If the artificial horn-ſilver (muriat of ſilver), be melted by itſelf on the ſpoon before the blow-pipe, it ſoon and readily fuſes into a globule; and, when combined with mineral alkali, the ſilver is immediately reduced. But the native corneous ſilver-ore does not melt ſo eaſily; it rather runs into the conſiſtence of pap, and at the ſame time ſeparate metallic grains tranſude. Its reduction, by means of ſoda, is ſomewhat more difficult than that of the artificial horn-ſilver, and the reaſon of this difference depends on the portion of iron contained in this ore.

b) Upon *two hundred* grains of the corneous ſilver-ore I poured three times their weight of pure nitric acid; but no action took place, either in the cold or in the heat of boiling; only a ſubtle brown-red iron-ochre was ſeparated, which, being waſhed off from the remaining ore, and dried, amounted to 4 grains. Cauſtic ammoniac, added to the nitric acid employed, precipitated 5 grains more of iron. When it was afterwards mixed with muriatic acid, only a pale milky colour was produced, but no real corneous ſilver-ore depoſited. It followed from this, that neither any free native ſilver, nor any portion of it mineralized by ſulphur, had been contained in that ore. The horn-ſilver, after treatment with nitric acid, was reduced by twice its weight of ſalt of tartar, and yielded 133 grains of reguline ſilver.

c) 1ſt. For the purpoſe of finding out, more accurately, its conſtituent parts, I mixed 200 grains with 600 grains of the pureſt alkali prepared from tartar, and brought the mixture into the ſtate of fuſion in a glaſs retort, applying the neceſſary degree of heat. After refrigeration, I broke off the upper half of the retort, ſoftened the fuſed maſs, which was of a light-brown colour, with hot diſtilled water, filtered the whole, and edulcorated the reſidue.

2dly. This reſidue was then diſſolved in nitric acid. The ſolution acquired a brown tinge, and the ſcum floating upon the liquor aſſumed the colour of bricks. When the argenteous parts were completely diſſolved, there remained $8\frac{1}{2}$ grains of a brown-red powder, which imparted a golden yellow colour to the aqua regia, with which it was digeſted, and left a white reſidue behind. This laſt conſiſted of horn-ſilver, mingled with a ſlight portion of the *gangue*, or *matrix* of the ore, and afforded, on reduction, 2 grains more of *ſilver*. Cauſtic ammoniac precipitated from the yellow ſolution 7 grains of *oxyded iron.*

3dly. The nitric ſolution of the ſilver was precipitated by common ſalt; and the muriat of ſilver thus obtained weighed, after reduction by means of ſoda, $134\frac{1}{2}$ grains of reguline ſilver.

4thly. The fluid, left after the ſeparation of the horn-ſilver, had a pale-yellow colour, owing to a *portion of iron*; which, precipitated by pure ammoniac, weighed 5 grains.

5thly After this, I proceeded to examine the ſaline maſs, diſſolved in diſtilled water, and ſeparated from the ſilver, after the corneous-ore had been fuſed with pure alkali (*i*). On ſaturating this maſs with diſtilled vinegar, the ſolution was rendered turbid, and a looſe white earth depoſited, which, collected and dried, amounted to $3\frac{1}{2}$ grains of *argillaceous earth.*

6thly. The argil being ſeparated, the ſolution was reduced to a dry ſalt by evaporation, and the alkohol, affuſed upon it, took up the acetite of pot-aſh. The neutral ſalt, which was left behind by this proceſs, and which conſiſted of the mineralizing muriatic acid and the alkali employed, I diſſolved in water, and obtained from it, by repeated evaporation and cryſtallization, 117½ grains of *muriat of pot-aſh.*

7thly. In order to learn whether and in what proportion *ſulphuric acid*, which by ſome writers has been mentioned as one of the conſtituent parts of the corneous ſilver-ore, were really preſent in it, I again diſſolved that ſalt in diſtilled water, and dropped into it liquid muriat of barytes. The mixture became turbid, exhibiting that appearance which indicates the preſence of only a ſlight quantity of ſulphuric acid. I continued to add the barytes, until no more turbidneſs appeared. The weight of the precipitate thus obtained was 3 grains: but, as in theſe three grains of ſulphated barytes the acid cannot properly be eſtimated to be more than half a grain, I think this quantity is too trifling to be conſidered as one of the eſſential conſtituent parts of the corneous ſilver-ore. But if that half grain of ſulphuric acid be eſtimated equal to 1½ grain of ſulphat of pot-aſh, and be ſubtracted from the above 117½ grain of digeſtive ſalt, or muriat of pot-aſh, there will remain of the latter only 116 grains, in which the concentrated muriatic acid amounts to 42 grains. Therefore,

One *hundred* parts of this corneous-ore contain

Silver	67,75
Muriatic acid . . .	21
Oxyd of iron . . .	6
Argil	1,75
Sulphuric acid . . .	0,25
	96,75

B.

I likewiſe examined the *corneous ſilver-ore* found in the *Schlangenberge*. *One hundred* grains of it, mixed with 300 of ſoda, were fuſed in a ſmall retort; and, after the ſaline contents of this maſs had been diſſolved in hot water, the remaining ſilver was diſſolved in nitric acid. I then fully ſaturated with muriatic acid the aqueous alkaline ſolution, which contained the common or culinary ſalt, formed by the muriatic acid of that ore, and put it to the teſt with muriat of barytes. The portion of ſulphat of barytes, thus generated, was as inſignificant as that from the Saxon corneous-ore; ſo that alſo, in this caſe, the ſulphuric acid may be conſidered only as an accidental conſtituent part.

To the nitric ſolution of the ſilver I added common ſalt; and thus I produced again the muriat of ſilver, which weighed 91½ grains, and afforded 68 grains of *ſilver*, reduced to the reguline ſtate. What was wanting to make up the firſt hundred grains of the corneous-ore, conſiſted of ferruginous ochre and quarzoſe matrix.

Hence it is obvious, that the *Siberian* corneous ſilver-ore here examined, almoſt perfectly agrees with the preceding *Saxon* one in its exterior characters, as well as in the conſtituent parts.

C.

The experiments made with the argillo-muriated ſilver-ore (*butter-milch ſilver*), deſcribed before (page 113), are the following:

a) Ignited by itſelf upon charcoal before the blow-pipe, it feebly conglutinated together, at the ſame time that minute globules of metallic ſilver were oozing through the maſs. When fuſed with glaſs of borax, it diſſolved into a clear, light-green, vitreous globule, and yielded a button of pure fine ſilver.

b) Upon 35 grains of that ore I poured nitric acid, and made it boil. Neither efferveſcence nor red vapours appeared; as, upon the whole, the acid ſeemed to attack it but weakly. The reſiduum aſſumed the form of a precipitate, reſembling a cheeſy coagulum. When the acid, then tinged of a faint blue, was ſeparated through a filter, it admitted of combination with common ſalt, without being rendered turbid, or yielding any precipitate. By the addition of corbonat of ammoniac to exceſs, argillaceous earth was thrown down, and the liquor appeared of a rather deep blue. But, after it had been ſuper-ſaturated with ſulphuric acid, and iron immerſed into it, it depoſited a thin coppery cruſt.

The dried reſidue weighed 30 grains. It was extracted by repeatedly pouring upon it cauſtic, or pure ammoniac, agitating it frequently. Nitric acid being added to a few drops of it, ſome horn-ſilver immediately precipitated. The whole of this ſolution, when evaporated by a gentle heat, dried up to cryſtalline flexible membranes of a pearl-grey, which tarniſhed into blue by expoſure to air; and, when gently melted in a ſmall ſilver-cup, ran into a waxy ſubſtance. The weight of this fuſed muriat of ſilver amounted to 10½ grains.

When the argil, that was left behind after the extraction of the horn-ſilver by ammoniac, was melted with ſoda, it ſtill afforded a bead of ſilver of ¾ of a grain. As this is equal to one grain of muriat of ſilver, the above 36 grains of this foſſil contained 11½ grains of muriated, or 8⅝ of metallic ſilver, and 2⅞ grains of concentrated muriatic acid.

Hence *one hundred* parts of the argillo-muriated ſilver ore contain,

Silver	24,64
Muriatic acid	8,28
Argil, with a ſlight trace of *copper* .	67,08
	100

It is owing to the argil contained in this ore that it does not aſſume the ſame appearance when heated on charcoal as the common horn-ſilver, but that the metal tranſudes in the reguline ſtate in ſmall globules; for as that earth deprives the muriated ſilver of its acid when heated, the ſilver is enabled to aſſume the metallic ſtate. And it is on this account that the ſame phenomenon took place when I mingled artificial horn-ſilver with argillaceous earth, and ſubjected it to ignition upon a piece of charcoal, with the aſſiſtance of the blow-pipe.

D.

With the view of inveſtigating the nature of the *ſilver-ore*, called *alkaline* by *Juſti*, I diſſolved *one ounce* of it in pure nitric acid, and mixed the filtered ſolution with muriatic acid. It, indeed, turned ſomewhat opaline; but no muriat of ſilver was ſeparated by this proceſs, nor was there any reguline ſilver precipitated upon immerſing into it a ſmall lamina of copper. Finding, therefore, that the portion of ſilver contained in the lime-ſtone could not be diſcovered in the nitric ſolution, I ſearched for it in the brown muddy reſidue of the filtered ſolution. This emitted an empyreumatic ſmell on being gently i weighed afterwards 2 grains, and yielded with pure a bead of fine ſilver. Hence it is probable, that foſſil the ſilver is combined with muriatic acid; and, r ing upon this reſult, the quantity of muriated ſilver it ſeems to contain, may be eſtimated at from *one half* to *two* ounces in hundred pounds. *Juſti* boa a method of extracting the ſilver from that mineral, to himſelf alone; as, when treated by any of the uſu ceſſes, this metal could never be procured from it.

As ſilver, notwithſtanding its great affinity with n acid, enters into no combination with it while in the reguline ſtate; and ſince that metal, as far as we kı never found in the bowels of the earth in an oxyde it is difficult to aſcertain the operation of nature i ducing the corneous-ore. *Bergmann*[*] was of o that *Woulfe* had ſolved that doubt by aſſerting, that above-mentioned ore he had traced the ſulphuric ac ſides the muriatic: for ſilver unites readily with ſu and, ſince ſulphurated ſilver not unfrequently under decompoſition, more eſpecially when, as in this caſe ı conjectured from the preſence of ferruginous ochre pyrites diſpoſed to diſintegration intervenes, the ſ paſſes over into the ſtate of a free acid, and forms ſul ſilver. If now muriatic acid interferes, it will, by vi its greater affinity to ſilver, decompoſe the ſulpha inſtead of it form corneous-ore.

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[*] *Torb. Bergmann* on the generation of natural corneous, riated metals. *Crell's Chemiſche Annalen*, 1784. Number 377.

Of that corneous ſilver-ore which is found in regular cubic cryſtals, *Bergmann* had already conjectured that it might be conſidered as pure, and free from all ſulphuric acid. He alſo wiſhed to convert this conjecture of his into an eſtabliſhed truth, by duly examining that foſſil; *for*, as he very juſtly ſays, *it is better to ſacrifice ſuch a ſpecimen, ſcarce as it yet is, to inveſtigation, rather than to deprive the ſciences of a means of enlarging our knowledge by preſerving it.*

The wiſh of the immortal *Bergmann* is in ſome degree accompliſhed, and his conjecture, for the moſt part, confirmed by the preſent enquiry; with the unimportant difference, however, that, inſtead of cryſtallized corneous-ore, I have employed a ſpecimen of that which occurs in lumps, or *maſſive*.

In order to comprehend how nature can generate the corneous ſilver-ore, without the interpoſition of ſulphur or ſulphuric acid, we may receive ſome light from the following intelligence, taken from a letter of *Prouſt*, in *Rozier's Journal de Phyſique.* It is there ſtated, that the coined ſilver of the Spaniſh ſhip San Pedro d'Alcantara, that was wrecked on the coaſt of Portugal, became coated with a blackiſh cruſt of $\frac{1}{48}$ of an inch thickneſs, during the ſhort time before it was recovered from the ſea. This cruſt broke off in ſcales, and was a true muriat of ſilver. Moreover, *Pallas*[*] relates, that he has found on the Jaik, in Siberia, ſeveral old Tartarian ſilver coins, which in that tract of ſaline land were converted into true muriat of ſilver, ſome throughout their whole maſs, and others on the ſurface only.

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[*] *Nordiſche Beytraege,* III. Vol.

From

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From this knowledge of the conſtituent parts of the corneous-ore, art is enabled to imitate nature pretty nearly. If muriat of ſilver be made to fuſe uniformly at a moderate heat, an artificial corneous-ore is produced, which may be made more ſimilar to the natural one by adding, before the fuſion, a proportional quantity of iron-ochre. And if muriated ſilver be diſſolved in cauſtic ammoniac, and the fluid evaporated in a gentle warmth, the horn-ſilver remains in ſmall glittering ſcales, reſembling thoſe with which the native corneous-ore is found in part covered. But, if this ſolution be left to ſpontaneous exhalation in the air, the horn-ſilver will ſometimes ſhoot into ſolid regular cryſtals, of the ſame appearance with the cubic cryſtals of the corneous-ore.

SECOND SECTION.

Red Silver-ore (Rothgültigerz).

The principal character by which this beautiful genus of ſilver-ores is externally diſtinguiſhed from others, conſiſts in a peculiar red colour, on account of which it is ſubdivided into two ſpecies, the *light*, and the *deep-red* ſilver-ore. The colour of the firſt varies from a bright ruby to a garnet red; that of the ſecond inclines more or leſs to a ſteel-grey, but the characteriſtic crimſon tint is ſoon made to appear by ſcraping or rubbing the ore. The deep-red ſilver-ore is uſually opake; the light-red, on the contrary, is in various degrees tranſparent.

With reſpect to external form, the red ſilver-ore is found *maſſive*, *diſſeminated*, *inveſting* or ſuperficial, *dendritic*, and at times regularly cryſtallized. Its cryſtals uſually poſſeſs the form of hexahedral columns, without any pointed termination, or ending in trihedral or hexahedral pyramids. The light-red ore alſo occurs in ſix-ſided pyramids.

The denomination of *Rothgültig*, or *Rothe gültiges Erz*, given by the older German miners to this genus of ſilver-ores, was intended to ſignify that it contained a portion of that noble metal, and thus to diſtinguiſh it from other ores, which reſemble it in form and colour; but, with reſpect to their argenteous contents, are *deaf* (*ungültig*), or of no value; inſtances of which are afforded by the native red ſulphuret of arſenic, red-blende, and garnet. In proceſs of time, this appellation has degenerated into *Rothgülden*, by which the unexperienced might be miſled to ſuſpect in this ore ſome portion of gold.

Concerning its conſtituent parts, it is the common opinion and doctrine, that the ſilver is mineralized in it by *arſenic*, as well as by ſulphur. Theſe three, *ſilver*, *ſulphur*, and *arſenic*, are in all elementary books of mineralogy, and by all authors, ſtated as the conſtituent parts of this ore, to which ſome add only a portion of iron. Among thoſe writers which, in *chemical mineralogy*, are reckoned claſſical, *Henckel* ſeems to be the firſt who mentions arſenic as one of the chief conſtituent parts of the red ſilver-ore, when he ſays, "*The high-red ore, beſides ſilver, conſiſts merely of arſenic; the deep-red contains ſulphur alſo.*" After him, *Wallerius* introduces it by the name "*Argentum arſenico et ſulphure mineraliſatum.*" *Cronſtedt* adopts this ſtatement, adding only ſome ferruginous ingredient. *Bergmann*, likewiſe, is of the ſame opinion, in his *Sciagraphia*[*], calling it "*Argentum cum arſenico ſulphure*

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[*] Torb. *Bergmann*, Sciagraphia regni mineralis. Lips. et Dreſd. 1782. page 108.

neraliſatum :" and, in his diſſertation de *Arſenico*[*], he
s, " *Arſenicum cum argento ſulphurato mineram argenti*
bram conficit :"—and at the ſame time he ſtates their pro-
tion to be, of *ſilver* 60, of *arſenic* 25, and of *ſulphur*
[†]. It was on the authority of theſe eminently learned
n that all the other writers have received the above-
ntioned component principles of this ore as unqueſtion-
e facts, and have transferred them into their works.

Yet, upon the whole, arſenic is not ſo general a minera-
er as has been hitherto ſuppoſed. Hence all the hypo-
eſes grounded on its pretended preſence, and according to
ich arſenic was conſidered as a principle neceſſary to the
neration or maturation of metals, eſpecially ſilver, can no
ger ſubſiſt. This ſuppoſition, which has never before
n queſtioned, that moſt genera of ſilver-ores contain
enic, has occaſioned the *prize queſtion* of the *Royal Aca-*
ny of Sciences at Berlin, 1773, " *To what purpoſes does*
Nature employ the arſenic contained in metallic ores?
Can it be proved, by experience, that it effectually ſerves
to bring the metals to maturity? And if ſo, in what man-

It is probable the red-arſenic, which externally reſembles the deep-red ſilver-ore, and, according to *Henckel's* teſtimony, uſed to be called *unripe red ſilver-ore*, has firſt ſuggeſted the idea of the preſence of arſenic in thoſe ores of ſilver.

After this digreſſion, I now proceed to the chemical analyſis itſelf. This, however, was particularly performed with the light-red ſilver-ore, of which I had an opportunity of ſelecting, for my repeated experiments, a ſufficient number of fragments, pure and free from extraneous matter, from the mines of the *Upper-harz*, and thoſe of *Saxony*.

A.

a) Upon *five hundred* grains of bright, cryſtalline, red ſilver-ore, from the pit *Catharina Neufang*, at *Andreaſberg*, moſt finely pulverized, I poured ſix times their quantity of a mixture of equal parts of nitric acid of 1,350 ſpecif. grav. and diſtilled water. The phial was kept for ſeveral hours in a low digeſting heat, ſo that the agency of the acid could be but moderate. I then diluted the ſolution with water; cauſed it to boil; and, after the reſiduum had ſubſided to the bottom, I decanted the clear ſolution. Upon the remaining pulverulent ore, a quantity of nitric acid and water, equal to the preceding, was again affuſed; and, in the ſame manner, proceeded with as at firſt. The ore appeared now to have been effectually decompoſed; and for this reaſon the ſolutions, together with the reſiduum, were put on the filter, and the latter properly waſhed.

b) The filtered nitric ſolution had no colour at all, having been very much diluted by the water by which the reſidue had

l been edulcorated. I ſubjected it to evaporation to one
hth part, and found the bottom of the evaporating glaſ-
ſel, after cooling, covered with copious, finely-grained,
lendent, and heavy cryſtals of a grey-white. To aſ-
tain their nature, I procured, by a ſeparate proceſs, a
ntity of a ſolution of the ſame red ſilver-ore, ſufficient for
enquiry, and found that they were *ſulphat of ſilver.*
ng aſſured of this, I diſſolved that ſulphat by a proportion-
quantity of water, aſſiſted by heat, added it again to the
ic ſolution, and combined this laſt with muriatic acid, as
g as any muriat of ſilver would precipitate; which, when
ected, edulcorated, and dried, was found to weigh
½ grains.

) The fluid, from which the horn-ſilver had been thus
rated, was then reduced to a ſmaller bulk, by diſtillation
a retort. This concentrated fluid became turbid, and
another grain of muriated ſilver on the filter. At this
it contained no other foreign ſubſtance, except a con-
rable portion of ſulphuric acid.

management, a white precipitate immediately enſued, which being ſeparated by the filter, edulcorated, and dried, and laſtly heated in a porcelain cup, gave 133 grains in weight. But I could not find the leaſt trace of arſenic in it, though I had ſubjected it to all the trials deemed proper for diſcovering its preſence. On the contrary, it was manifeſt, that this precipitate wholly conſiſted of *oxyd of antimony*, quite of the ſame nature with that which is produced when muriatic ſolutions of antimony are precipitated by water. On expoſing it to heat, a ſmall portion of moiſture ſtill evaporated, attended with a muriatic ſmell, which was hardly perceptible. When again put on a teſt, and mingled with a third part of charcoal duſt, the coaly powder was ſlowly conſumed, by burning, without any arſenical ſmell, and left behind it the metallic oxyd, poſſeſſed of a grey colour, and partly blended, partly covered with a quantity of fine, grey-white, ſhining, acicular cryſtals, or the flowers of antimony, as they are called. But when it was fuſed in a covered crucible with tartar and powdered charcoal, it was completely revived into *reguline antimony*, which being blown off with the bellows, a *bead of ſilver* was left, weighing half a grain.

f) The liquor alſo, from which the antimonial oxyd was ſeparated, contained free ſulphuric acid. On this account I put it into a retort, together with the nitric acid, from which the ſilver had been precipitated in the ſtate of horn-ſilver, by means of muriatic acid, and continued the diſtillation until, at this temperature, nothing more would paſs over; but, on raiſing the heat, thick white vapours had begun to riſe. The fluid left behind in the retort was found, upon trial, to be concentrated *ſulphuric acid*. Upon diluting this laſt with water, and ſubſequent affuſion of muriated barytes, the ſulphat of barytes from thence produced,

ed, amounted, after edulcoration and deſiccation, to 194
ins.

Conſequently, the conſtituent parts diſcovered by theſe
earches, are, *ſilver*, *antimony*, *ſulphur*, *and ſulphuric acid.*
remained yet to inveſtigate, what are the proportions
the manner of combination of theſe principles, which
ſtitute the red ſilver-ore.

Firſt, concerning the quantity of ſilver contained in this
here examined, the muriat of ſilver (*b*) together with
ſe portions that were left behind on the deflagration of
ſulphur (*d*), and the concentration of the fluid from
ich the former had been ſeparated (*e*), amounted, in the
ole, to 399 grains. Theſe being reduced, (including the
half grain obtained on driving off the antimony),
ded 300 grains of pure ſilver. This ſtatement alſo per-
ly agreed with the reſult of another experiment, which,
way of collateral proof, I performed in the dry way:
having, with this view, divided one *docimaſtic centner* of

lixiviating the ſaline parts, and deſiccation, weighed 130 grains. Hence the above 132 grains are equal to 101½ grains of metallic antimony.

With regard to the *ſulphuric acid*, it may be doubted, whether the acid here diſcovered, had really previouſly exiſted as ſuch in the red ſilver-ore, forming, with the metal, ſulphat of ſilver; or whether that acid ought not rather to be conſidered as a product, ariſing from the oxygenation of the ſulphur, while the ore was diſſolving in nitric acid. But even the external properties of that ore, eſpecially its tranſparence, and the abſence of metallic luſtre, will ſufficiently prove, that the latter is not the caſe: for, with regard to the mineralization, ores may be conveniently divided into two claſſes. The *firſt* comprehends the true ores in the ſtrict ſenſe; that is, thoſe only in which the metallic portion is either in the perfect, or very nearly perfect, reguline ſtate, and whoſe mineralizer is ſulphur. A metallic luſtre, and abſolute opacity, are eſſential properties of ſulphurated ores of this kind. To the *ſecond* claſs belong thoſe ores, the metallic part of which is acidified by oxygen, either alone, or in combination with ſulphur and acids. The exterior characters of the ores of this claſs are various. Some of them are *tranſparent* even to *pellucidity*; others, on the contrary, exhibit only an earthy appearance. But all theſe are particularly diſtinguiſhed from the genuine or true ores, by the total abſence of metallic ſplendour. Among the ſilver-ores, therefore, the *vitreous ſilver-ore (glaſerz)*, the *black ſilver-ore (ſprädglas-erz)*, and the *white ſilver-ore*, belong to the firſt claſs, or ſulphurated ores; but the *red*, and the *corneous ſilver-ore*, belong to the ſecond claſs, or ores mineralized by acid principles.

The peculiar manner in which the nitric acid exerts its diſſolving power on the red ſilver-ore during the digeſtion, affords another argument to ſhew, that in this ore the portion of ſilver does not exiſt in its perfect metallic ſtate, and mineralized by ſulphur; but, on the contrary, is combined with oxygen, at leaſt for the greater part; and hence, that it there exiſts in a calciform ſtate. The nitric acid acts upon it much too weakly, to oxygenate the ſulphur in any conſiderable degree; in conſequence of which, only a proportionally ſmall quantity of nitrous gas is produced in this ſolution. This fact is ſtill more confirmed by the following experiment. Some finely pulverized red ſilver-ore, together with a large quantity of ſtrong muriatic acid, were ſubjected to digeſtion for ſome hours, at a boiling heat. The acid, ſeparated by filtration, was examined after cooling, and was found to contain, not only ſilver, and antimonial particles, but alſo ſulphuric acid. Now, as muriatic acid alone is incapable of converting ſulphur into a free or uncombined acid, it follows, that the ſulphuric acid muſt already before have exiſted in that ore, in the capacity of an acid. Even *Henckel*, whoſe great merits in chemical mineralogy are at preſent almoſt totally diſregarded, has already ſtated it as a certain fact, that the ſilver may be extracted from its red-ore, by muriatic acid alone, aſſiſted by ſucceſſive digeſtions at the degree of boiling. It is alſo probable, that the ſulphuric acid, preſent in that ore, contributes to the ſolubility of the metal in the muriatic acid.

The ſulphuric acid, contained in the above 500 grains of the red ſilver-ore, produced 194 grains of ſulphated barytes. Other comparative experiments proved to me that this acid amounted to 85½ grains of 1,850 ſpecific gravity. But as this acid muſt be ſuppoſed to be combined in this ore with the ſilver in a concrete ſtate, or *freed from* water, and not in the ſtate of liquid ſulphuric acid, I hope to come pretty near the mark, if, till a more accurate computation can be made, I allow 40 grains for the ſulphuric acid of that degree of concentration.

In order to aſcertain whether any volatile parts, and of what kind, were diſcharged by the red ſilver-ore, when treated in fire with excluſion of air, *one ounce* of it, coarſely triturated, was placed in a ſmall glaſs-retort, which, being connected with the pneumatic quickſilver-apparatus, I continued to heat till the ore was in fuſion. However, nothing paſſed over into the jar filled with mercury, excepting that portion of atmoſpheric air, which was expelled from the retort by the heat. In the intermediate glaſs-balloon *volatile ſulphureous acid* collected, in the form of fine drops of dew; in the neck of the retort there appeared a ſlight trace of ſublimed yellow ſulphur; but the ore in the retort did not loſe ſo much as one entire grain of its weight.

Theſe ſame experiments, made for the purpoſe of diſcovering the ingredients in the red ſilver-ore, I repeated with another ſpecimen from the ſame mine; but, as the reſult of theſe laſt, excepting ſome unimportant deviations, agreed with the former, I am ſatisfied with the conſtituent parts reſulting from the inveſtigation of the above-mentioned 500 grains, and which are:

Silver	300
Reguline antimony	101,5
Sulphur	58,5
Concrete *ſulphuric acid*	40
	500 grs.

Therefore, *one hundred* parts of this *red ſilver-ore*, from *Andreasberg*, contain:

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Silver	60
Reguline antimony	20,3
Sulphur	11,7
Concrete *ſulphuric acid*	8
	100.

B.

The ſecond ſpecies of the red ſilver-ore, which I have lyſed, is the *bright-red and cryſtalline*, from *Churprinz* edrich *Auguſt*, near *Freiberg*. But, as I treated theſe in ſame manner as the preceding, I ſhall confine myſelf to reſults only; according to which, *one hundred* parts of ore contain :

Silver	62

In this *Saxon* red ſilver-ore, as in the foregoing, there was no veſtige of arſenical matter to be found, although arſenic conſtantly accompanies the ores dug out from that mine.

In the preceding analytical reſearches, concerning the red ſilver-ore, I have indeed mentioned *ſulphur*, and *ſulphuric acid*, as two particular products; yet I do not mean to ſay by this, that they are two ſeparate and really diſtinct conſtituent parts, actually exiſting in the ore. It is rather more probable, from the nature of the ſubject, to ſuppoſe, that in the undecompounded ore, both together conſtitute only one homogeneous ingredient part, and that the oxygen, by which the ſulphuric acid was generated in this proceſs, had before been uniformly diffuſed over the whole maſs of the ſulphur. But, if ſo, there is no doubt, but that the red colour of the ore, which in general is erroneouſly aſcribed to ſome arſenical matter, depends on that ſtate of ſulphur in its firſt degree of oxygenation, which by ſome is rightly called *oxyd of ſulphur*. On this account, the *ſilver*, *antimony*, *ſulphur*, and *oxygen*, are, in the ſtrict ſenſe, the genuine conſtituent parts of the red ſilver ore, taken in its natural ſtate.

Laſtly, I did not think it neceſſary to re-examine what *Bergmann* aſſerted, in his Eſſay de *Arſenico*, concerning the red ſilver-ore. He ſays—" *Minera argenti rubra egregie* " *aquâ forti decomponitur, argentum et arſenicum ſuſcipiente,* " *adeo, ut tandem ſolum ſulphur in fundo reſtet.*" From this it might be inferred, that *Bergmann* had employed for this experiment a ſpecimen of the red ſilver-ore, which had no antimony, but really ſome arſenic, among its conſtituent parts;

; otherwiſe, by the eſtabliſhed principles of chemiſtry,
antimoniacal part of the ore muſt of courſe, together
the ſulphur, have remained behind as a metallic oxyd,
uble in nitric acid. In order to ſet this contradictory
t in a proper light, I boiled five parts of ſtrong nitric
upon 100 grains of this red ore for ſome time; after
h the mixture was diluted with water, and the ſolution
ed while yet warm. This extraction by ſtrong nitric
was ſucceſſively repeated, until only a ſmall portion of
ur remained. The ſolution procured by the firſt di-
on, depoſited, in the cold, granular ſulphat of ſilver;
thoſe of the ſucceeding digeſtions yielded alſo ſome
cles of antimony, which ſubſided in delicate, light
s, of a ſilvery luſtre. By this experience, therefore, I
n, that reguline antimony, inſtead of being corroded by
c acid into an indiſſoluble oxyd, makes an exception
that rule when in combination with ſulphuric acid, as
here the caſe. And, for this reaſon, I found that a
ion of this metal was effected, when, by way of a

THIRD SECTION.

Vitreous Silver-ore. (Silberglanzerz.)

THE appellation *glaſerz*, which the German miners have given to this richeſt ſort of all ſilver-ores, is inconſiſtent with its real natural qualities, and can only have been retained from the antiquity of the term. Not only is the abſolute opacity of this ore, but alſo its ſoftneſs, and ductility, (on account of which it may be cut, hammered, and coined, as eaſily as lead) are abſolutely incompatible with the notion of *glaſs*. An inſtance of the laſt mentioned property is afforded by thoſe medals, which were made of it under the reign King *Auguſtus* I. (of Poland,) and had the impreſſion of his portrait. *Henkel*[*] was therefore fully entitled to ſay—"Glaſerz *is meant to ſignify the ſame as* "glanzerz, *which name it probably has received at thoſe* "*mines, where no other ore, conſtantly poſſeſſing luſtre, was* "*to be found*; *and, in particular, it ſeems, that the miner* "*who gave it firſt that name, happened to meet with a ſpe-*"*cies of glaſerz of variegated colours.*" Supported by this authority, and ſtill more ſo by the nature of that ore, I ſhall make uſe of the more ſuitable denomination, *ſilberglanzerz*.

That this ſpecies of ore is a mere *ſulphuret of ſilver*, is too well known to need farther confirmation. Only the proportion of its conſtituent parts, as ſtated by mineralogical writers, appeared to me to require correction. This, upon *Bergmann*'s[†] authority, is generally ſaid to be 75 parts

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[*] *Henkel redivivus.* page 51.

[†] *Sciagr. reg. min.* § 163.

of

and 25 of *ſulphur*. The portion of the ſilver is much higher by *Brünnich**: namely, at 180 marks, in the *hundred*. On the contrary, *Sage*† eſti- the ſulphur at 16 parts in the hundred of this ore, and quently the ſilver at 84. By the following experi- it will be ſeen, that of theſe two, the opinion of *Le* is the neareſt to truth. That this more accurate ſtate- was before known among the earlier authors in mine- is proved by theſe words of *Lazarus Erker*‡ "*This may reckon among the ſilver ores of eaſy fuſion, the eminent of theſe, the glaſerz, which is compact, of a colour, in quality nearly equal to native ſilver, and in the fire little more than one ſixth part, all the being good pure ſilver, &c.*"

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been accompliſhed, the remaining browniſh-yellow ſulphur, when ſeparated, waſhed, and dried, weighed 13 grains; but, on being burnt on a porcelain teſt, it left one grain and a half of ſulphated ſilver, which, fuſed with mineral alkali, gave a ſilver-button of one grain.

b) The colourleſs nitrous ſolution, when combined with common ſalt, edulcorated, and highly deſiccated in a warm temperature, yielded 122 grains of horn-ſilver, the metallic portion of which amounted to 84 grains. By this, including the above-mentioned *one* grain, the proportion of the ſilver contained in 100 parts of that ore is determined at 85.

c) The fluid decanted from the muriat of ſilver, contained nothing but a ſmall proportion of diſengaged ſulphuric acid. This, however, ſhould not in this inſtance be conſidered as a conſtituent part of the ore, but was undoubtedly formed during its long digeſtion in nitric acid. Hence thoſe 15 grains, which, after deducting the 85 of ſilver, remain to make up the 100 of the ore employed, may all be ſafely put into our account, as its ſulphureous part.

B.

Next, in order to examine the truth of the preceding reſult, in the dry way, I took the vitreous ſilver-ore from *Joachimsthal*, in Bohemia. An hundred grains of it were divided into two parts, and each of them placed in a ſeparate aſſaying teſt, well dried beforehand under the muffle. Heat was then applied, at firſt moderate, to drive the ſulphur

r ſlowly off, and only towards the end its intenſity was
eaſed to the requiſite degree. The beads of ſilver ob-
ed from each teſt, were of equal weight, and their ſum
unted to $84\frac{11}{16}$ grains.

n conſequence of the approximation of this laſt reſult
hat of the foregoing experiments, the conſtituent parts
ure, ductile, vitreous ſilver-ore, taken upon an ave-
, are proved to be:

Silver	85
Sulphur	15
	100

FOURTH SECTION.

Brittle Vitreous Silver-ore.

ſort of calcareous ſpar, cryſtallized in low ſix-ſided columns, with trihedral terminations, which is met with in the clefts of a rock of *Gneiſs*.

a) If ductile vitreous ſilver-ore be fuſed upon a piece of charcoal, by the aſſiſtance of the blow-pipe, its ſulphur is quickly volatized, and a button of pure ſilver remains. But it is otherwiſe with the brittle ore: for the bead left after the evaporation of the ſulphur is brittle, and cannot be purified by the addition of borax. However, if a little nitrat of pot-aſh is added to the red-hot bead, it will deſtroy the portion of baſer metal which it contains, and then the borat of ſoda cauſes it to yield a pure button of ſilver.

b) *One hundred* grains of ore, previouſly levigated, were gently boiled in a ſufficient quantity of nitric acid, diluted with an equal quantity of water. This operation was repeatedly performed, till the black colour of the powdered ore diſappeared, and the inſoluble portion had become of a looſe texture, and had acquired a grey-yellow colour. When filtered and dried, this reſidue weighed 26 grains.

c) On adding a ſolution of common ſalt to the above filtered ſolution, which had aſſumed a pale-greeniſh colour, a copious precipitate of horn-ſilver enſued, which, edulcorated and dried, gave 88¼ grains. Four parts of this afforded three of *ſilver*, by fuſion with ſoda.

d) The remaining ſolution was next combined with ſulphat of ſoda; but neither any turbidneſs, nor any indication of the preſence of lead, appeared. Upon this, cauſtic ammoniac was affuſed to exceſs; and the grey precipitate, which then fell down, and which the volatile alkali could not again render ſoluble, weighed five grains. Urged by heat, it melted into a conſiſtence, like pap, at the ſame time that a weak arſenical ſmell was perceived. After this precipitate had been once more diſſolved in nitric acid, the addition of ſoda cauſed it to yield a whitiſh-yellow, alkaline ſulphuret, a dirty brown, and Pruſſian alkali, a deep-blue precipitate, liable to the attraction of the load-ſtone, after ignition. Therefore, it conſiſted of *iron*, with a ſlight trace of *arſenic*.

e) The proportion of copper, indicated by a blue colour, in conſequence of the addition of ammoniac, and which ſtill remained in the ſolution, was but ſlight. For, after the ſolution had been ſaturated with ſulphuric acid, poliſhed iron immerſed in it, was inveſted with ſo ſlight a coppery cruſt, that no copper to any amount could be collected.

f) Thoſe 26 grains, which continued inſoluble in the nitric acid (*b*), were digeſted in nitro-muriatic acid, till nothing appeared to remain but the mere *ſulphur*. Its weight amounted to 13 grains; but, after deflagration, it left behind it about one grain of *quarzoſe matter* of the mine.

g) From this it is obvious, that 13 grains, or one half of the above 26 grains, were held in ſolution by the nitro-muriatic acid; and theſe were precipitated entirely in the form of a white powder, upon the affuſion of 20 parts of water. When ignited, this precipitate aſſumed a yellowiſh colour; but there was nothing, either of arſenic, or any other volatile ſubſtance, perceivable. By combination with ſoda, it became reduced to pure reguline *antimony*; which, as ſuch, admitted of being blown off without leaving any reſiduc, in its uſual form of a thick white ſmoke, adhering to the contiguous bodies in the form of needle-ſhaped flowers (*oxyd*) of antimony. Thoſe 13 grains of oxyded antimony are equivalent to ten grains of that metal in the reguline ſtate.

One hundred grains, therefore, of this foliated, brittle, vitreous ſilver-ore, contain:

Silver	*e*)	66,50
Reguline antimony .	*g*)	10
Iron	*d*)	5 .
Sulphur	*f*)	12
Copper and *arſenic*	*d*) *e*) about . .	0,50
Extraneous matter from the *mine* . . .		1
		95.

Conſidering the minute quantity of arſenic and copper, they can be reckoned only as caſual ingredients; and the ſame holds good with reſpect to the quarzoſe matrix. But, as the antimony exiſts in that ore, intimately combined with the ſilver and ſulphur, it muſt be conſidered as one of its eſſential conſtituent parts.

FIFTH SECTION.

White Silver-ore. (Weiſsgültigerz.)

Nature has not confined herſelf to one certain determined law, in fixing the proportions that obtain among the conſtituent parts of the *white ſilver-ore*. This fact accounts for the difference of colour, luſtre, and fracture, obſerved in the various ſpecimens of this ore; which alſo, for the ſame reaſon, has been often confounded with the brittle vitreous ſilver-ore, the grey copper-ore, the compact plumoſe antimonial-ore (*dichtes federerz*), and the compact galena, or potter's lead-

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lead-ore (*bleyſchweif*), &c. It is owing to this difference in the proportions of its component principles, that it is found, at one time, bright, and of a light grey; at another, of a lead-grey, and only glittering; of a fracture compact and even, ſometimes finely grained, or even paſſing into the fibrous texture. Hitherto it has not been met with, except in lumps and diſſeminated.

Of its conſtituent parts, few particulars have been given by former authors. *Henkel*[*] ſeems to be the firſt who enumerates them:—" *Weiſſgültiges Erz,*" ſays he, " *is properly a light, or bright-grey ſilver-ore, which yields* 14 *marks of that metal, if it be perfectly pure and compact. It contains, beſides, a little copper, arſenic, and ſulphur, of which, however, it is difficult to aſcertain the proportions.*" It is probably upon this authority of *Henkel,* that late writers unanimouſly ſuppoſe the eſſential ingredients of this ore to be *ſilver*, *copper*, *arſenic*, and *ſulphur*; to which *Cronſtedt*, *Bergmann*, *Kirwan*, and ſeveral others, add *iron*. *Wallerius* mentions two varieties of it: the one *without*, the other *with iron*. *Lehman*, on the contrary, ſuppoſes ſome *lead* inſtead of iron.

Yet, how little theſe ſuppoſed conſtituent parts agree with the real ones, will be manifeſt from the following experiments, made with the two principal ſpecies of the white ſilver-ore.

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[*] *Henkel redivivus.* Dreſd. 1747. page 57.

A.

Light white ſilver-ore.

a) Among various minerals, dug in the mine *Himmelsfürſt*, behind *Erbisdorf*, near *Freyberg*, I ſelected thoſe that contain the bright white ſilver-ore in ſolid maſſes. From theſe, when pounded, I picked out a ſufficient quantity of fragments, unmixed with the coarſe-cubical galena, which accompanies this ore. It was eaſily levigated, and afforded a blackiſh powder, ſoiling the fingers.

b) Upon *four hundred grains* of this powder, I poured four ounces of nitric acid, of the ſtrength before mentioned, and two ounces of water. After ſufficient digeſtion in a gentle heat, the ſolution was decanted, and the reſidue again expoſed to a warm temperature, with two ounces of that acid. This mixture I next diluted with eight parts of water, and continued to digeſt it for ſome time. I then ſeparated the undiſſolved reſidue, conſiſting of a greyiſh-white powder, which, after waſhing and drying, weighed 326 grains.

c) The ſolution, which was nearly colourleſs, was combined with common ſalt, by which a conſiderable quantity of muriated ſilver was immediately produced. The next day were found over the horn-ſilver, which lay at the bottom of the veſſel, tender needled cryſtals, which, upon cloſer examination, proved to be muriat of lead. On this account I boiled the whole precipitate in a large quantity of water, by means of which the muriated lead was re-diſſolved, and ſeparated from the muriat of ſilver, collected on

the

filter. This laſt, when reduced by fuſion with ſoda,
ded 81½ grains of reguline *ſilver*.

) What remained of the ſolution, together with the
or obtained by the decoction of the horn-ſilver, I eva-
ted in part; and by adding a ſaturated ſolution of Glau-
s ſalt, I obtained from it 45 grains of ſulphat of lead,
ch, upon reduction, afforded 32 grains of *lead* in the
allic ſtate.

) The remaining part of the ſolution I now ſaturated
h pure ammoniac; upon which a light-brown precipitate
down, weighing 40 grains, when edulcorated and
ted in a low heat. As that precipitate had the appear-
e of a mixture of iron and argil, I diſſolved it again in
ic acid, and precipitated, firſt, the iron by means of Pruſ-
alkali, and afterwards, by the addition of ſoda, a looſe
h, which, when deſiccated and ignited, weighed 28
ins, and, upon trial with ſulphuric acid, was found to be
minous earth. This, being ſubtracted from the above

grains of a grey reſidue, one of which diſſolved in muriatic acid, and was added to the preceding ſolution. The other grain was *ſiliceous earth*. The true quantity of the *ſulphur*, therefore, amounted to 49 grains.

g) While the muriatic ſolution was cooling, it depoſited a quantity of acicular cryſtals. Theſe being ſeparated, one half of the remaining fluid was diſtilled over in a ſmall retort, and, from the ſolution thus concentrated, more cryſtals, ſimilar to the firſt, were depoſited. This treatment was continued until no more cryſtals would form. When theſe cryſtals, collected together, were mingled with twice their weight of black flux, and reduced in an aſſay-crucible, thinly lined with charcoal-duſt, they afforded 160⅜ grains of lead. This lead, ſubjected to cupellation, emitted, at the firſt application of heat, a few antimonial vapours; it then fined quietly, and left a *button of ſilver*, weighing ⅛ of a grain. —This determines the proportion of *lead* at 160¼ grains; from which, however, a trifling quaintity ſhould be deducted for the portion of *antimony* before mentioned; though it could not be well determined, beſides that it could not weigh much above half a grain.

h) The fluid ſeparated from the muriat of lead, concentrated, and covered with a large quantity of water, depoſited its metallic part, which, in the form of a ſubtle, white powder, was only oxyded antimony, and being kneaded into a maſs with ſoap, was reduced in a luted aſſaying-crucible, by means of black flux, into 28½ grains of pure *reguline antimony*. Some more ſmall globules were found adhering to the lid of the veſſel, of which I collected three grains; but ſtill a ſmall portion appeared to have eſcaped through the joinings, and for this reaſon, the true amount of antimony, which I obtained, may be reckoned at ſomewhat more than the 31½ grains.

Hence the product of the 400 grains of the *light ſilver-ore*, here analyſed, conſiſted of:

Silver	*c*)	81½	81⅝ gr
	g)	⅛	
Lead	*d*)	32	192¼
	g)	160¼	
Reguline antimony	*b*)	31½ grs.	
Iron	*e*)	9	
Sulphur	*f*)	49	
Alumine	*e*)	28	
Silex	*f*)	1	
		392⅜ grs.	

Which, in *one hundred* parts, makes:

Silver	20,40
Lead	48,06
Antimony	7,88
Iron	2,25
Sulphur	12,25
Alumine	7
Silex	0,25
	98,09

With reſpect to the argillaceous earth, found in th ture of this ore, it may be queſtioned: Whether merely adventitious, or one of its conſtituent parts. the ſame time, there had been diſcovered in it a p tionate quantity of the ſiliceous earth, they might together be taken for a clayey matter of the mine, dentally intermingled with that ore. But, conſideri wide difference in the proportion of one part of ſilex of argil, the latter appears to be one of its actual conſtituent parts, though not eſſential.

B.

Dark White Silver-ore.

a) As of late this variety of the white ſilver-ore has but ſeldom occurred in pure maſſes in the Saxon mines, I ſacrificed to analyſis a ſpecimen, which was procured in the year 1720, from the pit *Junger Himmelsfürſt*, at Freyberg, and conſiſted of a ſolid, very pure, white ſilver-ore, of an inch in thickneſs, that croſſed lamellar galena.

b) From *two hundred* grains of this pure ore, finely pulverized, I obtained a colourleſs ſolution by the affuſion of three ounces of nitric acid, and an equal quantity of water. It was at firſt gently digeſted with the ore, then diluted with water, and, after a ſecond digeſtion, ſtrained through the filter. The ſilver, thus diſſolved, was precipitated by means of common ſalt. The muriat of ſilver, thus produced, and dried in a warm temperature, amounted to 24½ grains, which are equal to 18½ grains of reguline ſilver.

c) Afterwards, on combining this ſolution of the ore with Glauber's ſalt, ſulphat of lead was generated; the quantity of which, when edulcorated and dried, amounted to 93 grains, or to 66 grains of metallic *lead*.

d) Liquid cauſtic ammoniac ſeparated from the remaining fluid a browniſh, looſe precipitate, which, upon ignition, weighed 6½ grains, and, upon farther treatment, yielded 4½ grains of oxyded iron, (equal to 3½ grains of the reguli *metal*), and, beſides, two grains of *aluminous earth*.

e) By adding nitric acid, a greyiſh-white reſidue of 132 grains was left; which, when extracted with the neceſſar quantity of muriatic acid, left another reſidue of 52 grains of which, after its ſulphureous parts had undergone a ſlo combuſtion, only eight grains remained. Hence the pr portion of *ſulphur* conſiſted of 44 grains.

f) Theſe eight grains, digeſted with muriatic acid, wer diſſolved by it, except 1¼ grain of *ſiliceous earth*.

g) All the preceding muriatic ſolutions were then ſo fa reduced by ſlow evaporation, as to form numerous cryſtal After cooling, I cauſed the fluid which ſtill remained t drain off from the cryſtals; any foreign matter, that mig have adhered to them, I waſhed off with a mixture of on part of muriatic acid, and two of alkohol; and, aft deſiccation, I found their weight to be 22½ grains. The conſiſted of *ſulphat* of *lead*, the metallic portion of whic amounted to 16 grains.

h) The liquor, ſeparated from them, ſtill contained th *antimonial* ingredient of this ore. By dilution with a ſuf ficient quantity of water, a white oxyd of antimony wa thrown down; whoſe weight, upon drying at an increaſe temperature, proved to be 56 grains, and for which 4 grains of reguline *antimony* muſt be allowed.

It appears, then, that the dark, dull white ſilver-ore co tains in *one hundred* parts:

Silver	*b*)	9,25
Lead	*c*) and *g*)	41
Reguline antimony	*b*)	21,50
Iron	*d*)	1,75
Sulphur	*e*)	22
Alumine	*d*)	1
Silex	*f*)	0,75
		97,25

Conſequently, this analyſis of the above two varieties of the *white ſilver-ore* renders it evident, that it is neither *arſenic*, nor *copper*, but *lead* and *antimony*, which conſtitute the characteriſtic conſtituent parts of this ſpecies of metallic ore; and that the two laſt, for the future, ſhould be mentioned as ſuch.

Though theſe ores are uſually accompanied by galena, the lead found in them ſhould not, on this account, be conſidered as accidental; ſince it there exiſts in intimate mixture. It is a particular and remarkable phenomenon, and an anomaly in our knowledge of the elective attractions of bodies, that, even in the repeated digeſtions of the ore, neither the ſtrong nor dilute nitric acid is capable to diſſolve the whole of the admixed lead, and to deſtroy its combination with the antimonial ingredient.

Modern mineralogiſts have been induced, by the external and ſenſible differences of colour, luſtre, and fracture, which exiſt between the above two varieties of the white ſilver-ore, to regard them as two diſtinct ſpecies, and have introduced the ſecond into the ſyſtematical arrangement as the only genuine white ſilver-ore; ſeparating from it the firſt, which is of a brighter hue, and has been ranked with the brittle vitreous ſilver-ore, treated of at *Sect. IV.*

But as the reaſon for this claſſification was merely founded on ſome varieties of the external characteriſtic properties, it could only ſubſiſt as long as there was wanting a chemical inveſtigatirn of theſe two varieties of the white ſilver-ore, as well as the chemical knowledge of their component principles, which depends on that enquiry.

This deficiency being removed by the preſent analytical proceſſes, and it being demonſtrated that the conſtituent parts of both are of the ſame nature, differing only in their proportions, they ſhould be no longer deſcribed in ſyſtems of mineralogy as particular ſpecies, but only as varieties of *one* and the ſame ſpecies. For this reaſon, the *ſolid, brittle, vitreous ſilver-ore*, as it is called, ſhould be again removed from the claſs of the laſt-mentioned ſpecies, and ſhould reſume the place which it formerly occupied among the *white ſilver-ores*.

SIXTH SECTION.

Grey Silver-ore (Graugültigerz).

That ore of ſilver which I here introduce with this new name, is erroneouſly called *white* ſilver-ore *(Weiſſgülden)*, at *Kremnitz* in *Hungary*, where it is dug up both in maſſes and in white quarz. This laſt appellation is the more improper, as, with regard to luſtre and the colour of its fracture, it approaches nearer to the grey copper-ore *(Fahlerz)*, than the white ſilver-ore *(Weiſsgültigerz)*.

a) *Three hundred* grains of the fragments ſelected from the pounded ore, though not perfectly ſeparable from the quarzoſe gangue, with which they are firmly concreted, were levigated to a ſubtle powder, and digeſted with four times their weight of nitric acid. The digeſtion was renewed with the reſidue, in an equal quantity of the ſame acid; and the portion which ſtill remained undiſſolved then aſſumed a greyiſh-yellow colour, and weighed 188 grains.

b) By the addition of muriat of ſoda to the bright-green nitric ſolution, its ſilver was thrown down; and this precipitate, collected and reduced by means of ſoda, yielded 31½ grains of metallic *ſilver*.

c) The ſilver being thus ſeparated, I tried the ſolution for lead; but neither the neutral ſulphats, nor free ſulphuric acid, could diſcover the leaſt ſign of it.

d) After this I added cauſtic volatile alkali, ſo as to ſuperſaturate the acid; upon which a brown-reddiſh precipitate, of a looſe coheſion, appeared, that by ignition became of a black-brown, and weighed 9¾ grains. It diſſolved in nitric acid, leaving behind it half a grain of *ſiliceous earth*. Pruſſiat of pot-aſh produced from the filtered ſolution a deep-blue precipitate of iron; and after this was ſeparated, 1½ grain of *alumine* were obtained from it by means of ſoda. Therefore, ſubtracting the ſiliceous and argillaceous earths, the portion of *iron* attractible by the magnet amounted to 7¾ grains.

e) To the ſolution, which had before been over-ſaturated with pure ammoniac, and exhibited a blue ſapphirine colour, ſulphuric acid was now added to exceſs. A poliſhed piece of iron was then immerſed into the fluid, from which it precipitated 69 grains of copper.

f) The

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The above greyiſh-yellow reſidue (*a*) was now to be
nined. I digeſted it with ſix times its quantity of mu-
c acid in a heat of ebullition. When filtered, the re-
which was left on the paper being firſt waſhed with
iatic acid, then with a little alkohol, and laſtly dried,
found to weigh 105½ grains.

) From the ſolution which was obtained by the
proceſs, and was of a ſtraw yellow, the greater part of
fluid was drawn off by a gentle diſtillation in a retort.
remaining concentrated ſolution then depoſited ſome
alline grains, which were carefully collected, and
ed, upon inquiry, to be muriated ſilver, that afforded
ld of ſilver, weighing ¼ of a grain. A large quantity
ater being next poured into the ſolution, a copious pre-
ate ſubſided, weighing, after deſiccation, 97¼ grains.
roved, by every teſt, to be oxyd of antimony, for
ch, as I have found by comparative experiments, 75
ns of reguline *antimony* muſt be allowed.

Silver	*b*)	31½	32½ grains.
	g)	¼	
	i)	¾	
Copper	*e*)		69
Reguline Antimony	*g*)		75
Iron	*d*)		7¼
Sulphur	*h*)		25¼
Alumine	*d*)		1½
Silex	*d*)	½	80
	i)	79½	
			290½ grains.

But as the ſiliceous earth does not belong to the real mixture of the ore, but only ariſes from the admixed particles of quarz, it follows, that, when theſe are excluded from the computation, the true conſtituent parts of the grey ſilver-ore here examined, are, in the *hundred*, as follows :—

Silver	14,97 parts
Copper	31,36
Reguline Antimony	34,09
Iron	3,30
Sulphur	11,50
Alumine	0,30
	95,32

As, therefore, the foregoing analyſis plainly ſhews that no lead is contained in this *ſilver-ore* from *Kremnitz*, it cannot be any longer claſſed with the white ſilver-ores. For the ſame reaſon it would be equally improper to reckon it among the grey copper-ores : but, from the conſiderable proportions of noble metal which it contains, it has a juſt claim to the rank of a ſilver-ore, more ſo than even the white and poorer ores of that metal. Therefore, from analogy with the generic appellation, I have given it the name of *grey* ſilver-ore.

When it is conſidered that all the ſilver procured from the ores in Lower Hungary contains a portion of gold, and that this portion uſually amounts to one drachm (4 *denarien*) in the mark of the refined ſilver, which, in *Kremnitz*, is coined into money, there remains no doubt that the ore here analyſed likewiſe contains gold, as, indeed, ſome traces of it appeared in the courſe of this inveſtigation. But it would have required a diſtinct proceſs, performed too with a greater quantity of the ore, to have aſcertained the proportion of gold contained in it; which, however, was beyond the limits of the preſent inquiry.

According to an information given to me as authentic, this ore is ſaid likewiſe to contain mercury. Therefore, though no indication of this metal occurred to me during thoſe experiments, I thought it worth while to inſtitute a particular inquiry on that point. For this purpoſe I mingled 200 grains of the ore with 100 of quick-lime; and having put this mixture into a ſmall retort, connected with a receiver, filled with water, I expoſed the veſſel to the fire, increaſing the intenſity of heat until it became red-hot: but no perceivable trace of mercury appeared.

SEVENTH SECTION.

Native Amalgam of Silver.

Beſides the ſulphurated ores of ſilver, various other metallic mixtures are found in the mineral kingdom, which the ſilver, unaccompanied by ſulphur, enters as a conſtituent part. To theſe, among others, belongs the ſolution of ſilver in mercury, or the native *ſilver-amalgam*, which occurs chiefly in the quick-ſilver mines, and, in various forms, in the Duchy of *Deux-ponts.*

In order to aſcertain the proportion of theſe two metals to each other, I employed the amalgam, which is found in ſolitary, garnet-like cryſtals in the mine called *Vertrauen auf Gott*, at *Moſchellandsberg*. Some pure cryſtals of this amalgam, weighing together exactly 33½ grains, were inſerted into a barometer tube, of a diameter ſomewhat larger than uſual, the lower end of which had been cloſed by fuſion. This end being placed in ſand, within a ſmall crucible, I applied heat to it, increaſing its intenſity gradually and ſlowly to the degree of ignition. After cooling, I cut off the lower end from the tube, and found that it contained the ſilver, which had undergone ignition, in its former cryſtalline form, and weighing 12 grains. On collecting the mercury that had been ſublimed in the tube, I obtained 21 grains. Therefore, ſince the deficiency of ½ of a grain may be reckoned as a loſs of quickſilver, the following will be the proportion of the parts in one *hundred* of this *cryſtallized amalgam of ſilver*: namely,

Silver . . .	36
Mercury . . .	64
	100

EIGHTH

EIGHTH SECTION.

Arſenical Silver.

Another example of a metallic mixture, containing ſilver e from ſulphur, is the native *arſenical ſilver.* Its portion of ſilver varies from a few half ounces to ſeveral rks (of 8 ounces) in the centner, or one hundred pounds. nong the richer ſorts of this ore, I ſelected the ſpecimen, the lyſis of which is here given, and which was dug up from mine *Samſon*, at *Andreasberg*. Its gangue conſiſts white, coarſely-lamellated calcareous ſpar, in which the enical ſilver is contained, partly in lumps, partly diſſemi- ed in coarſe grains, but without any other kind of extra- ous ores.

) At firſt I ſeparated from the general maſs, coarſely inded in the mill, thoſe pieces of calcareous ſpar ich contained no portion of metal. Then I continued horn-ſilver was then freed from moiſture, and fuſed in a ſilver-crucible over a gentle fire; during which proceſs it emitted ſome arſenical vapours. Its weight was 28 grains, equal to 21 grains of *metallic ſilver.*

d) The ſilver being thus removed, I ſaturated the ſolution with vegetable alkali, procured from tartar. A light-red and very intumeſcent precipitate fell down, which, on drying, was rendered of a deep-brown. Ignition made the brown colour diſappear, and the precipitate now exhibited a light greeniſh-grey powder, inclining to white, and which weighed 160 grains. Being convinced that it was arſeniated iron, I put it on a roaſting teſt, mingled with one fourth part of powdered charcoal; and applied a low red-heat. By this treatment the arſenic became revived, and eſcaped in white vapours. The remaining iron was again repeatedly roaſted, with the addition of charcoal-duſt, till no arſenical ſmell could be any longer obſerved. The iron which at laſt remained had a black colour, weighed 106 grains, and perfectly obeyed the magnet.

e) The 71 grains (*b*), that continued undiſſolved in the nitric acid, were digeſted with muriatic acid, and towards the end were once more combined with a few drops of the nitric acid. Nearly all the powder was diſſolved, excepting a ſmall reſidue, coagulated like curds of cheeſe; which proved to be muriated ſilver, and by reduction with ſoda furniſhed a button of *ſilver*, of 4½ grains.

f) By dilution with water, this muriatic ſolution was rendered turbid, without any precipitation. But by ſaturating it with ſalt of tartar, a yellowiſh-green ſediment appeared, which, when collected, dried, and ignited, was found to weigh 32 grains. Upon diſſolving it again in a ſmall quantity of muriatic acid, a white precipitate was produced

duced by the affuſion of water; the quantity of w when dried in a warm temperature, amounted to 10½ gr On farther trial, it proved to be unqueſtionably an antim oxyd; ſtill containing, however, a ſlight trace of arſen iron. I eſtimate that oxyd at 8 grains of *reguline mony.*

g) What remained of the muriatic ſolution afforded combination with the above vegetable alkali, a precip which, when dried and roaſted, like the preceding (*d*), pulverized charcoal, yielded 18 grains of *oxyded iron.*

h) Deſirous of aſſuring myſelf of the abſence of ſulp I ſubjected 200 grains of the powdered ore to ſublima in a ſmall retort. Nothing but pure reguline arſenic raiſed; which, as uſual, fixed in the neck of the retort the form of a cruſt of a metallic luſtre, compoſed of accumulation of ſmall cryſtals.

i) It is then evident, that this ore conſiſts of ſilver, i arſenic, and antimony. However, when we reflect the arſenic, during the treatment of the ore with a combines with oxygen; and farther, that part of driven off in the oxyded ſtate, on the proceſs of roaſt and that part of it is taken up by the water employe waſhing the precipitates, the acid of arſenic being of ſolution in water, it is obvious that there exiſts a de of uncertainty in the attempt to aſcertain, with accur the proportions in which thoſe ingredients are united. Ne theleſs, the proportion of arſenic may be computed, propriety, from the loſs of weight requiſite to make up whole weight of the three remaining conſtituent parts the following manner:

Silver	*c*)	21		25½
	e)	4½		
Iron,				
Oxyd of iron attractible by the magnet	*d*)	106	124	
	g)	18		
which gives of metallic iron				88½
Reguline antimony				8
				122
The arſenic, therefore, would make (200—122=78)				78
				200

However, ſince, in the proceſſes of chemical analyſis of this as well as of other ſpecies, ſome loſs always unavoidably occurs in the ſum of the products, amounting from 2 or 3 to 5 or 6 in the hundred, regard muſt here be had to this circumſtance. Therefore, if the mean number of the loſs, which is 4, be ſubtracted, 70 will be left for the arſenic.

Hence, according to theſe premiſes, the *arſenical ſilver* examined in this analyſis contains, in an hundred parts,

Silver	12,75
Iron	44,25
Arſenic,	35
Reguline antimony	4
	96

Beſides the above eight ſpecies of ſilver-ores, the analyſis of which have made the ſubject of the preſent eſſay,

other

other kinds of argentiferous ores and metallic mixtures occur. But the greateſt part of theſe cannot be fairly conſidered as ſpecies of the genus of ſilver-ores; becauſe the proportion of the noble metal which they contain is too inconſiderable, when compared with their other conſtituent parts.

In general, I ſhould not wiſh to recommend the method hitherto uſed in the ſyſtematic arrangement, of denominating ores by the conſtituent part, which is of the greateſt mercantile value; though, on the other hand, I do not venture to aſſert, that, at the preſent period, the *predominant conſtituent part* alone ſhould ſerve as the principle, upon which to eſtabliſh the claſſification of foſſil bodies. If it were ſo, we ſhould only retain under the genus of ſilver (beſides the *native ſilver*) the *corneous*, the *red*, the *vitreous*, and *brittle vitreous ſilver-ores*; together with the black ſilver-ore (*ſilver-mulm*), which I had no opportunity to examine. And, on the contrary, the *white ſilver-ore* would then neceſſarily come under the genus of lead; the *grey* under that of antimony; the *ſilveramalgam* under that of mercury; and the *arſenical ſilver* under the genus of iron.

It is only by increaſing our knowledge of the chemical compoſition of individual ſpecies of foſſils that we ſhall be able to erect, on the relics of the preſent ſyſtem of mineralogy, another, which ſhall poſſeſs a more ſolid foundation, and ſhall be more conformable to nature.

X.

EXAMINATION

OF THE

ORIENTAL LAPIS LAZULI.

THOUGH the reſearches of Marggraf have refuted the opinion, formerly received, that the blue colour of the *Lapis Lazuli* originated from an admixture of copper; and though it has been demonſtrated that the colour of this foſſil is owing only to iron, yet its other conſtituent parts have not yet been determined with due accuracy. For this reaſon, I thought that a farther examination of it would not be ſuperfluous.

*Marggraf** mentions, indeed, and very juſtly, *lime*, *gypſum*, and *ſilex*, as the other conſtituent parts of the lapis lazuli, beſides a quantity of *iron*: but this account is ſtill incomplete, as he takes no notice of their reſpective proportions, and has, beſides, entirely overlooked the *aluminous earth* which it contains.

Rinmann† aſſures us, that this ſtone, beſides iron, calcareous earth, and quarz, contains alſo *fluoric acid*. Never-

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* *Marggraf*, Chim. Schriften I. Theil. Berlin, 1768, page 121.

† *Rinmann*, Geſchichte des Eiſens, 2 B. Berlin, 1785, page 136.

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leſs, I could not aſcertain the preſence of the latter. *nmann*'s ſuppoſition was probably occaſioned only by the oſphoreſcent light which iſſues from the lapis lazuli, en heated.

Cronſtedt, and others likewiſe, ſuppoſe the exiſtence of ver in this mineral, amounting to two *ounces* in 100 *unds*; but neither could I diſcover any clear indication of is ingredient. I choſe, for the following inquiries into the ture of the lapis lazuli, a pure ſpecimen of a deep-blue; d I firſt endeavoured, as much as poſſible, to free the gments from the white ſpots, and the particles of phur-pyrites with which this ſtone is always mixed.

a) *Hundred* parts of lapis lazuli loſt two parts in eight, by being ignited for half an hour in a porce- in crucible. Its colour ſuſtained no change.

From this conſiderable permanence of the beautiful ue colour, I was induced to try whether it would admit thing elſe than water. But the other 10 parts, which the ſtone loſes in a more intenſe heat, probably conſiſt of carbonic acid; ſince the efferveſcence of the lapis lazuli, when covered with any acid, weak as it is, ſhews that a part of its calcareous ingredient is diſſolved in that menſtruum.

c) *Two hundred* grains of finely levigated lapis lazuli were digeſted in a retort with muriatic acid, weakened by an equal quantity of water. The blue colour of the pulverized ſtone gradually turned to aſh-grey. When the mixture had reached a boiling heat, the powder was acted on with greater vehemence by the acid, and, after ſome ebullition, it formed a cheeſy-coagulum. I then diluted it with more water, added one part of nitric acid, and kept it boiling till the inſoluble reſidue had aſſumed a white colour. The ſolution, afterwards ſeparated by filtration, was of a pale yellow.

d) The reſidue had a ſandy appearance, and weighed 138 grains after drying. It was ſubjected to ignition with three parts of cauſtic, or pure pot-aſh. The greeniſh maſs which reſulted thence, when ſoftened with water, afforded a colourleſs ſolution, from which muriatic acid, added to exceſs, precipitated *ſiliceous earth*, weighing 57 grains when ignited.

e) This ſame ſolution (*d*), mixed with the above (*c*), and decompoſed in a boiling heat by carbonat of pot-aſh, yielded a yellowiſh-white precipitate, which, upon deſiccation, weighed 221 grains, and entirely diſſolved in muriatic acid.

f) Cauſtic ammoniac threw down from this ſolution a gelatinous precipitate, which, when digeſted with cauſtic alkaline lye, was not totally diſſolved, but left a yellow white reſidue, of 113 grains, in its dry ſtate.

g) By combining the liquid that remained from the p cipitation by ammoniac, with carbonat of pot-aſh, in boiling heat, 59 grains of carbonat of lime, or mild c *careous earth*, were obtained.

h) Upon the 113 grains, not taken up by the cau lye, I poured dilute ſulphuric acid. The mixture coa lated in heat to a gelatinous conſiſtence. When cove and digeſted with a large proportion of water, there ſe rated from it *ſiliceous earth*, the quantity of which, a being heated to redneſs, was 29 grains.

i) After the ſilex had been ſeparated, the ſolution mixed with ammoniac, and the precipitate thus formed conveyed, while yet moiſt, into boiling cauſtic lye. brown flocculent precipitate remained, which weig when dry, 13 grains. After they had been diſſolved in riatic acid, cauſtic ammoniac precipitated *oxyd of i* weighing 6 grains. After deſiccation, by adding ca nated ammoniac to the remaining fluid, 5 grains more *calcareous earth* were thrown down.

k) The alkaline ſolution (*f*) and (*i*) were then ſatur with muriatic acid. By this all that the alkali had ta up was ſeparated ; and this, when re-diſſolved, by an ditional portion of the ſame acid, I again precipitated carbonated pot-aſh. On re-diſſolving this laſt precipit in dilute ſulphuric acid, there appeared another portio ſilex, which, after ignition, was found to weigh 6 gra The ſulphuric acid, when poured off, and combined a due proportion of pot-aſh, afforded cryſtals of alum, w were re-diſſolved, and their *aluminous earth* precipit by means of mild, or carbonated alkali. After the alumine had been properly purified, deſiccated, and expoſed to red heat, its weight amouted to 29 grains.

l) I had before convinced myſelf, that in the lapis lazuli the whole of its calcareous earth is not combined with carbonic acid, but a portion of it with the ſulphuric acid; For this purpoſe I boiled a portion of pulverized lapis lazuli with a large quantity of water; which, when filtered, had an opaline appearance. Muriated barytes being then added as a teſt, ſome ſulphat of barytes was formed. In order to diſcover the proportion of the ſulphat of lime, or gypſum, contained in this ſtone, I took the fluid remaining from the precipitate mentioned at (*c*), together with the edulcorating water, and, after ſuper-ſaturation with muriatic acid, I examined it with a ſolution of muriat of barytes. The reſult was a precipitation of ſulphat of barytes which, collected and highly dried, amounted to 19½ grains.

It was reaſonable to conjecture, that not only the gypſum contained in the lapis lazuli, but alſo an accidental admixture of ſulphat of pot-aſh, in the cauſtic and mild alkali employed in the proceſſes (*d*) and (*e*), might have contributed to the formation of the ſulphated barytes, Therefore, to aſcertain this point, I diſſolved a ſimilar quantity of each, adding then muriatic acid, ſo that the acid predominated; and, laſtly, I combined the whole with muriat of barytes, In the reſult, there appeared 1½ grain of ſulphat of barytes. collected with care, An equal quantity, therefore, is to be deducted from the above 19½ grains. On this account, the above-mentioned 18 grains of ſulphated barytes were the proper ſcale, or meaſure, by which to determine the proportion of the gypſum ſought for in the preſent inſtance; and, calculating upon this ground, it followed, that the above 200 grains of decompoſed lapis lazuli contained

8,18 grains of free ſulphuric acid of 1,850 *ſpec.* or, if taken in combination with the lime which into that ſtone, 13 grains of gypſum. This computa founded on the reſults of my experiments: *firſt*, tha regarding minute fractions, 100 parts of ſulphuric : the above-mentioned ſpecific gravity, when ſaturate barytes, yield 220 of ſulphat of barytes; and, *ſecond*, the ſame quantity of ſulphurie acid, when ſaturate calcareous earth, forms 160 parts of gypſum: obſ however, that 100 parts of crude calcareous earth, bonat of lime, are required to ſaturate the acid; but c parts of pure, or burnt lime,

Conſequently, theſe 200 grains of *Lapis Lazuli* g following *remote conſtituent parts:*

Lime	*d*)	57	92 gr
	b)	29	
	k)	6	
Silex	*g*)	59	
	i)	5	
		64, ignited	35
Alumine	*k*)		29
Oxyd of iron	*i*)		6
Sulphuric acid	*l*)		8
Carbonic acid	*b*)		20
Water	*a*)		4
			194
		Loſs	6
			200 g

But ſince the calcareous earth, in the preſent ſubject of inquiry, is combined partly with ſulphuric acid, partly with the carbonic, the following muſt be reckoned as the *proximate conſtituent parts* of the lapis lazuli;

Silex	46
Alumine	14,50
Carbonat of lime	28
Sulphat of lime (gypſum)	6,50
Oxyd of iron	3
Water	2
	100

The reaſon of this exact agreement of the ſum of the conſtituent parts with the weight of the whole, is, that I have ſuppoſed the carbonat of lime to be *completely* ſaturated with the carbonic acid; which, however, does not ſeem entirely to be the caſe.

ſubſtance would precipitate. To the remaining portion pruſſiat of pot-aſh was added, and thus a deep-blue precipitate was produced, which, after ignition, was attracted by the magnet. From the ſolution, ſeparated from this laſt by filtering, liquid cauſtic ammoniac threw down ſome *aluminous earth* in a ſlimy ſtate. But the remaining fluid ſuffered no change, on the addition of carbonat of pot-aſh.

Silex, *alumine*, and *oxyded iron*, are then the conſtituent parts here diſcovered. But their reſpective proportions remain to be aſcertained by new experiments, to be performed with a greater quantity of this foſſil.

As, therefore, not the ſlighteſt trace of copper can be found in this foſſil, it is obvious that it cannot in any reſpect be conſidered as a mountain-blue.

Nor can I take it for a native Pruſſian blue, which it was conſidered to be, in conſequence of an inquiry made into its nature at Chemnitz. Its portion of iron affords no argument to the contrary; and the grounds of my opinion reſt upon the following obſervations.

1. *a*) The native Pruſſian blue is found only in mooriſh grounds or fens, and in thin ſtrata. It occurs immediately under the vegetable mould, and appears in the form of a looſe white earth, that becomes blue only when expoſed to air.

b) This blue foſſil, on the contrary, is concreted wit a hard vein of quarz, which is incloſed in a ſton matter of equal hardneſs. Beſides, its blue colou ſhews itſelf directly on every recent fracture; whic indicates that the foſſil was previouſly poſſeſſed of i

2.

it. When in the latter ſtate, a cryſtalline form of quadlateral flattened columns, or tables, is obſerved; though, n account of the quarz, which is perfectly concreted with t, the exterior, unbroken ſurface only, in ſome parts, exhibits the cryſtalline form. On theſe facets the foſſil is even, and of a moderate luſtre; but in the fracture, which is compact and rough, it is only glittering. It is opake; its ſtreak of a ſomewhat lighter blue; its hardneſs nearly that of quarz.

No ſign of any volcanic product preſenting itſelf in this foſſil, it was obvious, from the very mode of its appearance, that it could not, by any means, be a native ſmalt: for, muſt not the agency of fire have been preſent, to form a ſtony matter, naturally coloured blue by means of *cobalt?*

The following ſhort narrative of my reſearches concerning this foſſil, will alſo prove, that it is as far from being a *mountain blue*, or containing oxyded *copper*; notwithſtanding that this is given as the reſult of the chemical experiments made with it at Vienna.

Finding that all the acids which I poured upon this mineral, previouſly reduced into fine powder, and freed as much as poſſible from the aſſociated quarz, would not attack it with the requiſite force, I ſubjected it to a low red-heat, combined with twice its weight of pot-aſh, procured from tartar. After refrigeration, I obſerved that the blue colour had entirely diſappeared, and the maſs had aſſumed a yellowiſh-white. When this had been triturated, ſoftened in water, then ſaturated to exceſs with nitric acid, digeſted and filtered, there remained undiſſolved *ſiliceous earth.* The ſolution had no colour. In one part of it I immerſed poliſhed iron; but neither copper, nor any other metallic

In the native Pruſſian blue, the oxyd of iron is combined with phoſphoric acid; as I have proved in another place[*]. But it is ſtill unknown, by what ſubſtance the oxyd of iron, contained in the foſſil from Vorau, is modified ſo as to acquire the blue colour.

Another inſtance of a ſimilar blue colour imparted by iron, is afforded by the *Oriental lapis lazuli.* It differs, however, from the preceding, in this, that its blue colour is conſiderably more permanent in the fire; for, ſo long as the ſtone is but moderately ignited, its colour continues unaltered, and is changed only when the ſtone is urged by a ſtronger heat, and is brought into the ſtate of fuſion. The lapis lazuli is alſo diſtinguiſhed from the foſſil from Vorau, beſides its other conſtituent parts, by a proportion of calcareous earth, which is the cauſe of its melting in fire.

If the above foſſil likewiſe contained lime, I ſhould not heſitate to range it as a variety of the lapis lazuli; as has been already done by Mr. *Stütz*[†], with the name of *ſpurious lapis lazuli.* Perhaps may the denomination *lazulite* be not quite improper.

Note. I have once mentioned that foſſil, as a particular ſpecies of ferruginous earth, or oxyded iron, with the name of *iron-blue from Vorau*; but its proportion of iron ſeems to be too ſmall to entitle it to that place.

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[*] Chemiſche Annalen. 1784. 5tes Stuck. Seite 396.

[†] *Neue Einrichtung der K. K. Naturalienſammlung zu Wie* Wienn, 1793. Seite 49.

OF THE

ON, OR JARGON OF CEYLON.

FIRST SECTION*.

G the rough or uncut precious ſtones coming from
there occurs a particular genus, hitherto little no-
hich is diſtinguiſhed from other gems by the fol-
haracters.

lour conſiſts of various ſhades of pale yellow-green,
liſh, altogether inclining to a dim ſmoke-grey.
lly, a greaſy gloſs is obſerved, and it feels ſmooth.
of the individual ſtones is inconſiderable; com-
o or 30 of them weigh only one drachm. The
figure of their cryſtals is a rectangular four-ſided

very few ſpecimens only; as for the greateſt part merely looſe, minute, rounded grains (*abgerundete g*

But this kind of gems is eminently diſtinguiſh ſpecific gravity, which I have found to be 4,615[†].

Romé de l'Iſle was the firſt, to my knowledge, tions theſe gems as a particular ſpecies of ſtone them the name, *Jargon of Ceylon*, and ſtating thei according to *Briſſon's* experiments, at 4,416. Ot ralogiſts and writers; who notice this ſtone, claſs with the ſapphire, others with the topaz, others ruby, others with the diamond, and ſome with cinth. But *Werner* has aſſigned to it a peculiar the mineralogic ſyſtem, immediately under the and the chryſoberyl, and called it *Zircon* (*Silex ci*

The jargons do not loſe much of their weig nition; for, upon igniting 300 grains for the ſpa hour and a half, and with the greateſt intenſity c found the loſs to be only one fourth of a grain. nition I repeated three times, and quenched th each proceſs in water. The ſtones became by t the brighter ones loſt their ſmoke-grey appear were rendered ſimilar to cloudy white-grey qu ſome of the darker ſpecimens, as well as ſome pa brighter, turned reddiſh. Their natural hardneſs, did not ſeem to have been impaired.

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[*] A more circumſtantial deſcription has been given *ling*, in his *Lehrbuch der Mineralogie*, *I. Th. Gieſſen*, 179 *Widenmann*, in his *Handbuch der Mineralogie*, *Leipzig*,

[†] Yet I have afterwards found a difference in the ſpeci of the various ſpecies; however, the leaſt weight that was as high as 4,530.

A.

a) By way of a preparatory analyſis, 200 grains of jargon were levigated in a flint-mortar to a very ſubtle powder of a white colour, inclining to a pale fleſh-red, which I mingled with equal parts of carbonated pot-aſh, expoſing it to a red-heat for one hour in a ſilver-crucible. It then formed a conglutinated maſs, which, upon trituration, I ſaturated to exceſs, and digeſted with muriatic acid. But this did not at all appear to attack it, as I obtained again the jargonic powder without the leaſt alteration, and with the loſs of only half a grain.

b) For this reaſon I afterwards blended the ſame powder with ſix times its quantity of the above alkali, prepared from tartar, and ignited it ſtrongly during five hours. The maſs was rendered compact, and brought to the point of fuſion: yet, when ſoftened with water, and digeſted with muriatic acid added to exceſs, the powder of the ſtone was likewiſe found but little altered; and, after waſhing, drying, and ignition, I recovered it with no more loſs than two grains.

c) Upon this, I once more added 1200 grains of the above alkali, and kept the maſs in an ignited ſtate, until it actually fuſed; which, after being again ſuper-ſaturated with muriatic acid, left behind it 197 grains of undecompoſed jargon.

d) I next put this powder into a retort, and poured upon it five times its quantity of ſtrong ſulphuric acid, adding to it one ounce of water; and when the liquor had been diſtilled off to dryneſs, I ſoftened the reſidue with water. But even by this proceſs the ſtone underwent no obſervable change. The reſidue, when lixiviated and dried, reſembled, as before, a fine ſandy powder, and weighed 196 grains. From the acid fluid, ſaturated with alkali, one grain of a white earth fell down.

The obſtinacy with which the jargon reſiſted every attempt to decompoſe it in the above manner, abated my ardour in purſuing farther this experiment. But, having in the mean time become acquainted with the powerful efficacy of cauſtic fixed alkalis in looſening the coheſion of particles in the various ſpecies of gems, I reſolved to employ them alſo for the jargon, and proceeded to the following new experiment.

B.

a) *Two hundred grains* of finely pulverized jargon were ignited for two hours in a ſilver-crucible, with four times their weight of cauſtic ſoda, and with ſuch an intenſity of heat, that the maſs continued in a ſtate of pulpy or thick fuſion. Upon refrigeration, the maſs proved to be very hard, and was gradually ſoftened by repeated affuſion of boiling water. The alkali ſeemed to have totally loſt its former cauſticity, the ſolution taſting like a weak carbonated lixivium. When it had been ſufficiently ſuper-ſaturated and digeſted with muriatic acid, I did not obſerve that any ſiliceous earth ſeparated; and the undiſſolved reſidue remained behind on the filtering paper in the form of a fine ſand-like powder, weighing, after deſiccation and ignition, 172 grains.

b) That reſidue, when again treated in the ſame manner with four times its weight of cauſtic ſoda, afforded a very firm porous maſs, which, after being digeſted with muriatic acid, in the manner related, left behind 148 grains of jargonic powder.

c) The ſame proceſs of adding to it four times its weight of cauſtic ſoda, and ſubſequent digeſtion in muriatic acid, was repeated with this laſt. After this treatment, there ſtill remained 127 grains.

d) This, treated again for the fourth time in the ſame manner, left 97 grains.

e) As my ſtock of cauſtic ſoda was now exhauſted, I prepared, inſtead of it, a cauſtic vegetable alkali, and added to the above undecompoſed 97 grains of jargon ſix times their weight of the above alkali, and kept the maſs, during ſeveral hours, in as intenſe an ignition, as the ſilver-crucible was able to bear without melting. However, its fuſion went on but ſlowly, and was of a pulpy conſiſtence. Even boiling water would but difficultly liquefy the refrigerated maſs. But, when it had been ſaturated to exceſs, and digeſted with muriatic acid in the degree of boiling heat, a total ſolution of the jargon enſued.

f) I now poured together all the ſeveral preceding ſolutions. The whole of them exhibited a tranſparent fluid, but ſomewhat opaleſcent, and with a few light flocculent particles floating in it. I then ſaturated this liquor with carbonated, or mild pot-aſh. The earth, which ſeparated by this management, gave to the mixture an appearance of milk. But when collected on the filter, and waſhed, it firſt aſſumed the form of paſte made of ſtarch, and afterwards dried up to lumps of a vitreous appearance, and of a whitiſh colour, verging upon the grey-green. The f filtered off from it, together with the waſhings, ſtill de ſited in a warm temperature a ſmall portion of ea which I added to the above precipitate.

g) This precipitate contained now all the conſtitu parts of the jargon under examination, but deprived their native coheſion. *One half* of it I digeſted with ounce of ſtrong muriatic acid, in a heat of conſiderable tenſity, and thus I obtained a turbid yellowiſh ſoluti from which the undiſſolved part ſlowly ſubſided upon d tion with water. After the ſuperincumbent liquor had b decanted, and the reſiduum digeſted with an equal quan of boiling muriatic acid, I filtered the ſolution, and dried undiſſolved reſidue, which ſtill remained.

h) As, in this inſtance, it was my principal deſign to cover, whether any calcareous earth was preſent, I pre pitated the diſſolved portion from the muriatic ſolution means of cauſtic ammoniac. It fell down as an extreme looſe ſubſtance, reſembling a tranſparent ſlime. But neitl carbonated ammoniac, nor carbonated pot-aſh, would p duce the leaſt turbidneſs, when added to the ſeparated cl liquor. This ſhews, that it contained no calcareous eart which was alſo confirmed by ſeveral other teſts or re-age employed for that purpoſe.

i) Upon the *ſecond half* of the above precipitate (*g*) affuſed a triple quantity of concentrated ſulphuric acid, a abſtracted it again by diſtillation to dryneſs. From the re dual maſs again ſoftened with water, and which looked li diſſolved ſtarch, I ſeparated the undiſſolved part by filtrati But the filtered ſulphuric ſolution, which was as limpid water, when combined with various precipitating me

exhibi

the ſame phenomena with thoſe ſhewn by ition, prepared with muriatic acid.

ole of the earth, which remained from both (*g*) and (*i*), weighed, after ignition, 86½ grains, abled a fine ſandy powder. It was then mingled our times its weight of carbonated pot-aſh, and ſubd to ignition in a ſilver-crucible, until it entered into plete fuſion. When the maſs was again ſoftened in ater, it was found ſtill hard, and of difficult ſolution. However, a very ſubtle, heavy, and, apparently, tenacious earth, was depoſited, which, collected and ignited, was found to weigh 28½ grains.

l) The clear and colourleſs alkaline lixivium I divided into two parts. *One half* of it I ſaturated with muriatic acid; by which treatment, a white, puffy, gelatinous earth ſeparated, no portion of which, however, would re-diſſolve, by adding a ſuperabundant quantity of the ſame acid. The *other half* I firſt diluted with plenty of water, and then gradually ſaturated it to exceſs with muriatic acid. It continued clear and limpid; and by this I was convinced, that the above was *merely ſiliceous earth*; which, therefore, after deducting the 28½ grains of earth from the 86½ grains that were fuſed with the pot-aſh (*k*), amounted to 58 grains.

Note. This is the order of examination in which I proceed, with reſpect to thoſe earths, which, on analyſis, I have ſome reaſons to conſider previouſly as belonging to the ſiliceous genus. By this method I moſt ſurely avoid the error, perhaps not unfrequent, of immediately calling any earth, that on the firſt attempt does not appear to diſſolve in acids, merely ſiliceous. I likewiſe largely dilute with water the alkaline ſolution of the ſiliceous earth, and combine it to exceſs with any acid—(in which caſe, however, no precipitate enſues, becauſe the ſiliceous earth thus circumſtanced is really ſoluble in water. And when upon this I evaporate it to dryneſs, with the aſſ ance of heat, and ſoften again the dry ſalt with water, I fi the ſiliceous earth, that was before held in ſolution, at t bottom of the veſſel, in the form of fine cryſtalline grains ſand.

m) Thoſe 28½ grains of earth, that were left behind the treatment with alkali (*k*), I digeſted in a boiling he with an abundance of nitro-muriatic acid. A reſidue w left, weighing, upon ignition, 16 grains.

n) Theſe undiſſolved 16 grains, blended with ſix parts cauſtic pot-aſh, were expoſed for ſome hours to a red he The colourleſs fluid, which was filtered off from the m when again liquefied with water, was not rendered tur by the addition of ſulphuric acid. But when expoſed tc raiſed temperature, it formed a gelatinous maſs, which, ter thorough deſiccation, and the ſeparation of the rema ing ſalt by ſubſequent affuſion of water, left three grains *ſiliceous earth* behind, in the form of ſand.

o) The remainder of the alkaline ſolution (*n*), was ſi jected to digeſtion with boiling aqua regia. The ear contrary to cuſtom, ſwelled into a ſlimy matter, and the quor acquired a greeniſh tinge. I filtered the ſolution p viouſly diluted with water; mixed it with the precedi which was likewiſe prepared with nitro-muriatic acid (*m*), added pruſſiat of pot-aſh. The greyiſh-green precipit thus produced, when heated to redneſs, weighed no m than half a grain. The portion of *oxyded iron*, thus tected in the jargon under examination, may therefore eſtimated at one fourth of a grain.

Note. Some phenomena which appeared on examining this p cipitate, obtained by means of pruſſiated pot-aſh, led me ſuſp ſuſpect a ſlight trace of the preſence of Nickel. However, ſince, on every ſubſequent examination of the jargon, no ſuch indication any more occurred to me, I think the above appearance to have been merely accidental.

p) Carbonated vegetable alkali, being then added to the nitro-muriatic ſolution, precipitated of a white colour the remaining portion of earth, which it ſtill contained. This earth, upon examination, was found to be of exactly the ſame nature with that obtained from the firſt ſolutions.

q) After the reſidual undiſſolved earth had been ignited, it weighed five grains. I conſider this as the remainder of the rough jargon, which had eluded the attempts to decompoſe; it the farther analyſis of which, from the minuteneſs of its quantity, could not be undertaken.

C.

I now proceeded to the cloſer examination of that part of the jargon, which was found to be ſoluble in acids.

a) According to the eſtabliſhed rule, the above ſulphuric ſolution (B. *i*) ſhould be ſuppoſed to contain either magneſian, or aluminous earth, or a mixture of both. However, the taſte gave not the leaſt indication of either. On the contrary, it was hardly diſtinguiſhable from that of pure ſulphuric acid, and but gently aſtringent. In endeavouring to cryſtallize it, I expelled a part by evaporation, combined the remainder with a proportionate quantity of pot-aſh, and waited to ſee whether aluminous cryſtals would form. It is true, on farther evaporation, there ſeparated a cryſtalline milk-white cruſt; which, however, could not be taken for alum, but only ſulphat of pot-aſh, together with which a portion of the diſſolved earth was depoſited.

b) To carry the experiment farther, I diſſolved the above-mentioned ſaline ſediment in water; and in order to collect the whole quantity of the jargonic earth, I likewiſe diſſolved that portion of it, which I had recovered from the muriatic ſolution (B. *g*), by means of ammoniac, as well as that which I had precipitated by vegetable alkali, from the nitro-muriatic ſolution (B. *p*). Both theſe laſt I diſſolved in dilute ſulphuric acid, and added the ſolutions to the preceding.

c) I now once more directed my attention to the metallic ingredient in the jargon, to detect which, I could employ only the pruſſiat of pot-aſh. The firſt portion which was added, produced in the colourleſs ſolution a dirty olive-green; but ſubſequent additions, made by degrees, tinged the mixture of a deep-blue. After the blue precipitate had ſubſided, it was collected and dried. It weighed three grains; of which the proportion of *iron* may be eſtimated at a fourth part, that is, three fourths of a grain.

d) Upon this I ſaturated the whole of the ſulphuric ſolution with cryſtallized alkali, prepared from tartar; on which the earth, which ſeparated, imparted to the mixture an uniform, milky appearance. The earth thus depoſited and waſhed, was ſubjected, while yet moiſt, to the following experiments.

e) In diluted and gently warmed ſulphuric acid it diſſolved without any effervеſcence, though it had been precipitated by carbonated alkali; which ſhews, that this earth has no affinity with carbonic acid. The ſulphuric acid took up a large quantity of it. I continued adding this earth to the acid, until the laſt portion gave the ſolution an opaline appearance; but this again diſappeared on the addition of a ſlight quantity of ſulphuric acid, ſo that the ſolution then became clear. After cooling, it congealed into a milk-white, pulpy ſubſtance. For this reaſon I again added a little ſulphuric acid, which, aſſiſted by a low heat, rendered the ſolution again limpid, ſo that it no longer coagulated in the cold. I then left it ſtanding at reſt in a low temperature, and after ſome days I found the greateſt part of it ſhot into ſmall, detached, and clear cryſtalline groups, in radii of a flattened quadrilateral columnar form, diverging from a common centre, and terminating in ſharp points. Their taſte was but little ſour, and left on the tongue a ſlight aſtringency. When thrown into water, they ſoon and eaſily diſſolved, at the ſame time that they loſt their limpidity and became turbid. The remainder of the ſolution ſtill afforded ſome cryſtals of a fine granular form; and the laſt portion thickened into an irregularly ſhaped maſs.

f) Diſtilled vinegar, concentrated to a fourth part of its bulk by freezing, diſſolved the earth with equal readineſs, receiving from it the peculiar taſte already mentioned. This acetic ſolution dried by heat into a pulverulent reſidue, deliqueſcing in the air.

g) I likewiſe boiled a portion of the jargonic earth with a lye of concentrated and cauſtic lixivium of pot-aſh, previouſly heated to boiling. The earth merely ſubſided in it in a looſe, flocculent form, without being diſſolved.

h) It is, then, manifeſt, from the foregoing experiments, that the *Jargonia*, or jargonic earth, is entirely different from the aluminous. That it is equally diſtinct from the magneſian earth, has already been proved by the total abſence of all magneſian taſte in the ſulphuric ſolution,

n, as well as by its incapability of abſorbing carbonic
d. However, that no circumſtance might be left unex-
ored in this examination, I re-diſſolved in ſulphuric acid
portion that yet remained; and having ſaturated with
bonat of lime the ſolution heated to boiling, I filtered
fluid from it after cooling. But neither the taſte, nor
y other re-agents, could diſcover the ſmalleſt ſign of
gneſia.

i) When this earth was tried with the blow-pipe
on charcoal, the phoſphoric ſalt proved unable to diſ-
ve any part of it, although its action was long conti-
ed; for the earth remained in the clear globule of that
without any alteration. Nor was it found in any way
acked, when fuſed with ſoda in the ſmall ſilver-ſpoon.
wever, it diſſolved by degrees, completely, and without
bling, in glaſs of borax; and the bead, thus produced,
tinued perfectly clear and colourleſs.

theſe reſearches, whereby the reſults of my own may be either confirmed or corrected.

The proportion of the ingredients, conſtituting the jargon, is yet left to be determined. But it is obvious, that, whenever new conſtituent parts are diſcovered, the nature of which is as yet entirely unknown, and which do not admit of being treated by the methods hitherto practiſed, the determination of their proportions cannot be brought to that high degree of accuracy, which may be expected when the Chemiſt purſues a beaten path, and cannot want a chemical knowledge of the conſtituent parts which he meets with in the ſubject under his examination.

Hence, as from the *two hundred* grains of the jargon, ſubjected to this analyſis, I obtained

Silex . .	B. *l*) . . .	58 grs.	61 grs.
	n) . . .	3	
Oxyd of iron .	*o*) . . .	¼	1
	C. *c*) . . .	¾	
Remainder of undecompoſed *jargon* .	B. *q*)		5
The quantity of this newly diſcovered JARGONIA may be eſtimated at			133
			200

And ſuppoſing that theſe remaining undecompoſed five grains contain the ſame proportion of conſtituent parts, we may eſtimate the ingredients in 100 parts of the jargon to be the following:

Silex	31,50
Oxyd of iron . . . . : . .	0,50
Jargonia	68
	100

SECOND SECTION.

SINCE repeated experience has ſhewn me the powerful
uence which the cauſtic alkali, when employed in the
uid ſtate, exerts in promoting a more complete decompo-
on of the harder ſpecies of ſtones, I could not avoid ſub-
ting the jargon likewiſe to this method of treatment.
t to avoid ſuperfluous prolixity in this eſſay, I ſhall con-
the circumſtantial detail of theſe new experiments to
t analytical proceſs only, which I have found the moſt
venient.

cold; another part of it remained undiſſolved, and was ſeparated by filtration. The ferruginous contents of this laſt yellowiſh ſolution were again thrown down, in the form of brown, flocculent particles, by means of cauſtic ammoniac; after which they were collected and ignited upon charcoal. The precipitate appeared then in black, ſhining grains, which obeyed the magnet, and weighed ¼ grain.

That portion which would not again diſſolve, and which ſtill preſerved its former yellowiſh-white hue, I likewiſe heated to redneſs, upon a piece of charcoal. By this management it acquired a faint, dark-brown colour at the firſt moment of ignition:—a phenomenon which does not uſually take place, except in the white oxyd of mangaueſe. This portion weighed ¾ of a grain.

c) Upon the pulverized jargon, after treatment with acids, and adding the above-mentioned reſiduum of ¾ of a grain (*b*), I poured two ounces and a half of a cauſtic lye, in which the ſaline part made half the weight. The whole was then inſpiſſated in a ſilver-crucible to dryneſs, and moderately ignited for two hours; by which treatment the maſs preſerved a pap-like conſiſtence. When refrigerated, I ſoftened the indurated, grey-white maſs with water. The powder of the ſtone, thus ſeparated from the alkaline lye, when waſhed and dried in a low-heat, now reſembled elutriated chalk, and weighed 128 grains.

d) I then ſaturated the clear alkaline lixivium (*c*) with ſulphuric acid. By this it was not rendered turbid; but only after it had been evaporated to dryneſs, and the ſaline maſs again ſoftened with water, there appeared *ſiliceous earth*, amounting to three grains after ignition.

e) The

) The above jargonic powder (*c*), being now prepared
ſolution in acids, I firſt affuſed upon it eight times its
ight of water; and upon this mixture, which had aſ-
ied a milky appearance, I poured a ſufficient quantity of
ite ſulphuric acid. In this menſtruum, aſſiſted by heat,
whole of the powder (a few impurities excepted), diſ-
ved into a limpid, colourleſs liquor. After cooling,
re ſettled around the ſides and bottom of the glaſs-veſſel
irregular cruſt, conſiſting of white cryſtalline grains;
ch again diſſolved upon affuſing more water of a warm
perature. This being done, the colourleſs ſolution was
porated with a low heat. At the beginning of the pro-
ſ it remained clear, but afterwards it coagulated into
uniform, pellucid jelly.

) When this gelatinous coagulum had again been di-
ted with a large quantity of water, it diſſolved into the
n of tranſparent, viſcid grains; which, collected on the
r, and deſiccated, reſembled glaſſy ſand. Theſe being
oſed to a red heat, with four parts of mild vegetable al-
i, and the maſs re-diſſolved in water, left behind

when ignited, amounted to 17½ grains; which gives 69 for the whole.

Therefore, the conſtituent parts of the *jargons*, analyſed, are, *in one hundred*,

Jargonic earth	g)		69,
Silex	d)	3	
	f)	24	
		27	
From which ſubtracted	a)	½	
		26½	26,50
Oxyd of iron	b)		0,50
			96
		Loſs	4
			100

B.

I ſhall farther mention ſome of my other analytical proceſſes, repeated on that ſubject under circumſtances ſomewhat diverſified, and alſo the obſervations which have occurred to me concerning the chemical habitudes, or relations of jargonic earth.

a) Both the accurate diſcovery of the proportion of the ſiliceous earth, and its thorough ſeparation from the earth of jargon, are rendered highly difficult by their intimate union, as well as by their reciprocal ſolution of each other. This end I have attained, in the ſureſt way, by the method juſt

now

ow deſcribed: and for this reaſon I recommend this as the ſt among ſeveral that I have attempted. However, ere ſeems to obtain ſome little difference in the propor- on of the ſiliceous earth, depending on the nature of the veral varieties of the jargon; which is likewiſe made obable by the ſmall differences in the ſpecific weight of rious ſpecimens of this ſtone.

b) If, upon the maſs obtained by ſoftening the jargon ith water, after its ignition with cauſtic alkali, muriatic fulphuric acid be immediately poured, to a ſlight degree ſuper-ſaturation, the whole is directly diſſolved, clearly, d without reſidue. The earth precipitated by means of kali from this ſolution, hardens, during deſiccation in armth, into tranſparent, vitreous, heavy, ſolid, and brittle mps; which, in the moment they are removed from the at, fly into ſmall pieces, with vehemence and noiſe; me of which, if not incloſed in paper, are often thrown to great diſtance. The higher the temperature in which the rth has been dried, the greater is the reſidue left behind diſſolved, when again conveyed into acid menſtrua, for united with the precipitated iron, that the above precipitate acquires a pale, reddiſh colour after ignition, and is hardly attracted by the magnet.

Conſequently, not ſo much with the view of aſcertaining the proportion of the conſtituent parts, as to produce the *jargonia* abſolutely free from iron, it is adviſeable to re-diſſolve the earth firſt obtained, in an acid, and to ſeparate that ſmall remainder of iron by pruſſiated alkali. The iron being thus got rid of, the earth of circon, now perfectly pure, ſhould be at laſt precipitated by means of an alkali, in a heat of ebullition.

d) To obtain the circon-earth in a ſtate of eaſy ſolution in acids, it is neceſſary that, after precipitation and waſhing, it ſhould be dried in a gentle heat only. Strongly ignited earth of jargon will not diſſolve in acids, unleſs again previouſly prepared for that proceſs by igniting it along with cauſtic alkali.

e) When the jargonia is to be precipitated from acid ſolutions, by means of carbonated pot-aſh, the point of ſaturation ſhould not be exceeded; ſince, otherwiſe, in proportion to the exceſs of alkali added, it will, either in part or wholly, be re-diſſolved in the fluid, and can only then be made to re-appear by adding freſh acid to the ſuperfluous alkali. However, this earth is not re-diſſolved, if the precipitation is performed by cauſtic vegetable alkali, though the fluid ſhould happen to be ſuper-ſaturated with the ſalt.

f) Of all the acid ſolutions of jargonic earth, that which is prepared with muriatic acid has the greateſt tendency to cryſtallize. If committed to ſpontaneous evaporation, the *muriat of jargonia* ſhoots into very ſlender, acicu-

r cryſtals, radiated in a diverging direction, which con-
nue dry on expoſure to air.

g) The jargonia is not at all diſpoſed to vitrifaction;
hich is proved by the following experiment. A glaſs
t, compoſed of 60 grains of jargonia, and 40 grains of
ild alkali prepared from tartar, was expoſed, in a cruci-
e made of clay, to an intenſe and long continued fire.
it by this proceſs not only was no union of theſe two
bſtances effected, but they even entirely ſeparated. The
kali fixed itſelf on the ſides of the veſſel in indurated
ains; and in the middle the jargonic earth lay by itſelf,
the form of a coarſe, harſh, and looſely conglutinated
wder, of a yellowiſh-white colour.

XIII.

CHEMICAL EXAMINATION

OF

HYACINTH.

ON giving the firſt information of the new ſimple earth diſcovered in the Jargon of Ceylon, I declared, at the ſame time, my earneſt deſire of ſeeing this diſcovery farther purſued, and confirmed by probatory reſearches of able chemiſts. That wiſh, however, remained unfulfilled, with the exception of ſome few experiments made by *Gmelin.* It is probable that the few opportunities, which have hitherto occurred of obtaining jargon pebbles in a ſufficient quantity, have prevented chemiſts from inſtituting a particular inquiry into their nature. They will, therefore, it is hoped, find pleaſure in hearing, that the ſame earth is likewiſe contained in another gem, the *Hyacinth*, which may be eaſily obtained, and in ſufficient quantity. This information will, perhaps, cauſe ſurprize, ſince the analyſis of the Hyacinth, publiſhed by *Torb. Bergman*, appears to have been long ſince confirmed by its general reception. According to this, the Hyacinth is ſuppoſed to conſiſt of,

40 . . .	*Argil*,
25 . . .	*Silex*,
20 . . .	*Lime*, *and*
13 . . .	*Oxyd of iron.*

Therefore, to obviate all doubts that may ariſe concern-
the correctneſs of my preſent analyſis, I declare be-
e hand, that it is not merely the reſult of one ſingle and
perficial decompoſition of the Hyacinth, but of ſeveral
alyſes of that gem, performed at different intervals of
ne, and in every reſpect complete.

The native country of the Hyacinth, which was the ſub-
t of the following experiments, is *Ceylon*.—Whether
oſe ſpecies of ſtones, which in European countries, in
hemia, *Italy*, and *France*, for inſtance, are indicated
this denomination, are true Hyacinths, I have not,
yet, been able to convince myſelf by any ſatisfactory
oof.

I have found the ſpecific gravity of the genuine Hyacinth *b*) This pulverized hyacinth, digeſted with two ounces of nitro-muriatic acid, yielded, upon ſaturating the ſolution with pot-aſh, a light-brown precipitate, of 3¼ grains, when dried. Ammoniac, added to it, diſſolved nothing; and it remained colourleſs. After the precipitate had been again ſeparated from the volatile alkali, I put it into muriatic acid, which diſſolved its ferruginous contents, leaving a white earth behind, which, when ignited, weighed 1½ grain. The portion of *iron*, precipitated by cauſtic ammoniac from the muriatic ſolution, weighed ½ grain, when ignited, and became black and reſplendent. I fuſed it with a neutral phoſphat, upon charcoal, in order to find whether it contained manganeſe; but no trace of it was perceptible.

c) The above 1½ grains of earth (*b*) were now added again to the hyacinth, after treatment with acids. The ſtone was then ſubjected to red-heat, with ſix times its quantity of cauſtic alkali, in the manner explained in the eſſay on the jargon of Ceylon; the ignited maſs was again liquefied with water; and the earth remaining after this proceſs weighed 123 grains, when collected, edulcorated, and dried.

d) The alkaline lixivium was then ſaturated with muriatic acid, and evaporated. At firſt it continued clear; but towards the end *ſiliceous earth* ſeparated, the quantity of which, after ignition, amounted to 6 grains.

e) Upon thoſe 123 grains, previouſly well waſhed with water, I poured a ſufficient quantity of muriatic acid; which, with the aſſiſtance of heat, diſſolved nearly the whole, a trifling reſidue excepted. This muriatic ſolution, evaporated in a moderate heat to a ſixth or eighth part, loſt its fluidity, and formed a limpid gelatinous coagulum.

It was then covered with water, and expoſed, with repeated agitation, to a digeſting heat. By this management, the *ſiliceous earth* ſeparated in ſlimy, intumeſced grains, and weighed, after ignition, 23½ grains.

f) The ſolution, thus freed from its ſilex, was now ſaturated with a boiling lye of mild alkali; and the precipitate was waſhed and dried in the air. This laſt weighed 114 grains, proving, upon every trial, to be *jargonic earth*. A fourth part of it, heated to redneſs, weighed 16½ grains; which make the whole amount to 66 grains.

g) The above 6 grains (*d*), with the 23½ grains (*e*) in the whole 29½ grains of ſiliceous earth, were ignited with a quadruple weight of vegetable alkali. When this maſs had been again ſoftened with water, it left a reſidue, which I extracted by muriatic acid. From this muriatic ſolution, alſo, when ſaturated with pot-aſh, jargonic earth fell down, weighing 4 grains after ignition. Hence, ſubtracting theſe, the quantity of ſiliceous earth is reduced to 25½ grains.

One hundred parts of *hyacinth*, therefore, have given

Jargonia . .	*f*) . .	66	. . 70
	g) . .	4	
Silex . . .	*g*) . .	25½	
Subtract .	*a*) . .	½	
		25	. . 25
Oxyd of iron .	*h*)		0,50
			95,50
		Loſs	4,50
			100

What I have already mentioned, when treating of the jargon of Ceylon, both with reſpect to the variation in the proportion of the ſilex, and the ſmall quantity of iron ſtill remaining, which may be ſeparated by means of Pruſſian alkali, applies likewiſe to the hyacinth.

Hence, the *jargon* of Ceylon, and the *hyacinth*, ſhould, in future, be ranked in the ſeries of natural bodies as *two ſpecies*; or, if it be preferred, as *two genera*, under *one* peculiar and diſtinct *order of ſtones.* But which of theſe two is entitled to preference, in giving its name to the genus?—The jargon has, indeed, already obtained that diſtinction; but ought it not to be transferred to the hyacinth, being a gem much older, longer known, and more eſteemed?—If ſo, the denomination *hyacinth-earth* ſhould then be adopted, and ſubſtituted to that of *circonia*, or *jargonia.*

XIV.

CHEMICAL EXAMINATION

OF THE SUPPOSED

HUNGARIAN RED SHÖRL.

THE foſſil, found at *Boinik*[*], in Hungary, and called *red Shörl*, is there dug up from a bed of quarz, ſtratified with ſhiſtoſe mica. Its colour is a pale browniſh-red. Its figure is a column ſtrongly furrowed, or channelled, lengthways, which, in my ſpecimens, exhibits a rectangular parallelopipedon. The larger ſpecimens which I poſſeſs are ½ inch thick; but theſe ſhörls are commonly thinner, and form only needle-ſhaped cryſtals, the external ſurfaces of which are ſtriated, and, as well as thoſe of the fragments, ſtrongly ſhining. Their croſs fracture is foliated; the longitudinal fracture of a medium between the foliated and uneven, and in ſome parts of the minute conchoidal. The ſplinters of this foſſil, and thin edges, are tranſparent, like the light-red ſilver-ore, which, in general, it very much re-

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[*] *Born* mentions *Rhoniz* as the place where it is found. See his *Catalogue Meth. et Rais. de la Collect. d. Foſſil.* Tom. i. p. 168.

reſembles when in fragments. It breaks into ſmall acute-angular pieces, which, however, ſhew a very great hardneſs on trituration; and the colour of the powder is between the orange and brick-red. Its ſpecific gravity I have found to be 4,180.

It was undoubtedly the oblong form, together with the ſtriated, fluted ſurface of its cryſtals, which occaſioned this foſſil to be claſſed under the tribe of ſhörl: whereas other mineralogiſts think themſelves entitled, from its colour and fracture, to reckon it a garnet.

But it will be made evident by the reſults of the following analyſis, that this mineral body belongs neither to the one nor to the other of thoſe ſpecies of ſtones, nor at all to the claſs compriſing the genera of earths and ſtones. On the contrary, it will appear that it conſiſts of a *peculiar, diſtinct, metallic ſubſtance**.

A.

a) I expoſed a piece of this mineral, in a *crucible made of clay*, to the heat of the porcelain furnace. By this it ſuffered no change as to figure and luſtre; but the colour paſſed into a deep brown-red.

b) Another ſpecimen, that was ſubjected to a porcelain heat in a *charcoal-crucible*, burſt into angular grains; while its colour changed to a faint light-brown, and ſcarcely an of its original luſtre remained.

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* For the quantity of this rather ſcarce foſſil, requiſite to this analyſis, I am indebted to the kindneſs of *Count Würben*, of Vienna.

c) When fuſed with an alkaline phoſphat, upon charcoal, before the blow-pipe, no ſolution enſues. The globule acquires a pale reddiſh-grey, and turns opake. A gentle preſſure makes it fall aſunder, in the form of ſand.

d) Melted borat of ſoda (borax) diſſolves it, uniting with it to a clear vitreous bead of an hyacinthine red.

e) If the powder of this foſſil be fuſed in the ſilver ſpoon with *ſoda*, it gradually diſſolves, and the globule becomes untranſparent, and of a reddiſh white colour, after cooling.

B.

In order to examine the agency of acids on this mineral, when finely pulverized, I inſerted ſeveral portions of it in *four* ſeparate phials, and poured upon one *ſulphuric*, upon the other *nitric*, upon the third *muriatic*, and upon the laſt *nitro-muriatic* acid; ſubjecting them all to long digeſtion in a ſtrong heat. No action enſued in either; for the foſſil was again taken out of each acid without any alteration.

C.

Having blended *one hundred grains* of the foſſil, finely levigated with four times its weight of cauſtic pot-aſh, I expoſed it to a red-heat for one hour. When removed from the fire, I ſoftened it by water, ſuper-ſaturated with muriatic acid, and ſubjected it to digeſtion. There ſeemed but little of it diſſolved, and the undiſſolved part lay at the bottom of the veſſel, as a white, tenacious, and heavy earth. When the mixture was thrown upon the filter, in order to ſeparate the fluid, it paſſed through the pores of the paper in the form of milk. For this reaſon, I put the whole again together into one maſs, diluting it with a greater quantity of water; and the earth having ſubſided after 24 hours, the water was decanted, and the ſediment dried in a warm temperature. By this management it again acquired a reddiſh colour.

This ſeemed to indicate that the coheſion of this ſhörl was not yet perfectly looſened. I therefore ignited it once more with 200 grains of the cauſtic ſalt, and again digeſted, with muriatic acid, the maſs previouſly ſoftened. Even in this caſe the mixture reſembled milk, and continued ſeveral days in this ſtate, without becoming clear. I diluted it then with more water, and made it boil: upon which the earth ſeparated in detached, flocculent particles, which then admitted of being collected on the filter. But they adhered to it very firmly and clammily; which, upon exſiccation, rendered its ſeparation difficult.

I inſtituted ſeveral preliminary experiments with that portion which could be collected; by which I learnt, that, in this inſtance, I was engaged with a peculiar *metallic oxyd*.

D.

I repeated the decompoſition of the foſſil with ſuch a variation of the proceſs, as to avoid the difficulty in ſeparating and collecting the precipitate, which took place in the preceding attempts.

Two hundred grains of the foſſil, finely pulverized, a mingled with five times their quantity of carbonated alk were ignited in a porcelain-pot. The mixture entered i a thin fuſion; but when poured out, it coagulated to greyiſh-white, denſe maſs of acicular cryſtals, at the upp ſurface, and of a fibrous fracture. This I triturated a liquefied in boiling water. A white precipitate ſoon ſu ſided, from which the ſupernatant liquor was filtered o and ſaturated with muriatic acid. By this management, white, ſlimy earth fell down, that weighed eight grai after drying, and conſiſted of a mixture of argillaceous a ſiliceous earths.

The reſiduum, waſhed, and deſiccated in a gentle he appeared as a white looſe earth, and weighed 328 grains.

E.

This white earth was ſubjected to a number of expe ments; the reſults of which were, as follows.

1. *Its relations to acids.*

a) It ſoon diſſolved in *dilute ſulphuric acid*, and affor a clear ſolution, which, when expoſed to the air, eva rated, leaving a white, turbid, paſte-like ſubſtance beh it.

b) *Nitric acid* likewiſe formed with it a limpid ſoluti By ſpontaneous evaporation, this acquired an oily conſ ence, and depoſited minute tranſparent cryſtals, the pri tive figure of which was an oblong rhomb, and ſeemed change into an hexahedral plate, or table, by the truncat of its two oppoſite acute angular ends.

c) When the ſolution of this earth in *muriatic acid* was left to evaporate of itſelf, it thickened to a bright-yellow, clear, gelatinous ſubſtance, beneath which there ſhot a quantity of very ſmall, clear, cryſtalline grains, of a cubical form.

In theſe acid ſolutions there remained between five and ſix parts of *ſiliceous earth* in the hundred. However, a quantity of *ſiliceous earth*, to appearance ſtill more conderable, was yet left behind, in combination with the white earth, and entered with it into the ſolutions. It is by this circumſtance that theſe ſolutions are reduced to a gelatinous coagulum, and that a more regular cryſtallization is impeded.

2. *Relations of theſe ſolutions to the precipitating media.*

a) *Carbonat of pot-aſh* precipitates the diſſolved earth in a white, light, flocculent form.

b) *Cauſtic ammoniac* produces the ſame effect.

c) *Pruſſiat of pot-aſh* affords a large precipitate, mixed of graſs-green and brown.

d) *Tincture of galls*, or *gallic acid*, throws down a brown-red precipitate, of very conſiderable bulk. If the ſolution has not been previouſly diluted with much water, it congeals like blood. Alkalis ſeparate nothing from the decanted fluid. The precipitate, when collected, waſhed, and dried, has the appearance of *Kerme's mineral* (red ſulphurated oxyd of antimony). When I expoſed 15 grains of this powder to a weak heat, upon coals, in a ſmall crucible, it immediately glimmered, and turned white. After this degree of ignition, it was found to weigh 6 grains.

e) When combined with *acid of arſenic*, a white pr pitate enſues.

f) The ſame is occaſioned by *phoſphoric acid.*

g) *Acid of tartar* produces a white precipitate, but wh ſoon entirely re-diſſolves.

h) The ſame takes place upon the addition of *oxalic ac*

i) A ſmall *ſtick of tin* was immerſed in a phial, full of muriatic ſolution of the foſſil, and provided with a ſtopp After ſome minutes a faint roſe-colour ſhewed itſelf arou the ſtick of *tin*, paſſing, at laſt, into a beautiful amethyſti red.

k) Another phial, capable of being cloſed with a ſtopp was filled with this muriatic ſolution, but diluted with times the quantity of water; and into this I put a ſm ſtick of zinc. The ſolution at firſt changed to a viol but afterwards to a deep indigo-blue. When placed ir warm temperature, in an uncovered diſh, the ſolution grad ally loſt its colour, and depoſited a white, bulky precipitat which, when ſeparated by filtration, and again diſſolved muriatic acid, retained the ſame properties as the earth before the ſolution.

l) But the muriatic ſolution, when combined w *Hahneman's acidulous liquor, impregnated with ſulphure gas* *, remained unaltered.

m) However, *Beguin's ſulphuret of ammoniac*, added that mixture, gave it a dirty, green colour, and produce blueiſh-green precipitate. If the white earth, in the

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* Hahneman's *Wine Proof.* See *Gren's* Principles of Chemiſt vol. ii. page 253. *note.*—Tranſl.

ate, be covered with this fluid, it is immediately tinged of a browniſh-green.

3. *Habitudes of the above-mentioned earth in the dry way.*

a) *Fifty grains* of the white earth, mentioned above, when ignited in a crucible, were afterwards found to weigh 38 grains. As long as it continued warm, it exhibited the yellow colour of ſulphur; which, however, diſappeared upon cooling. This earth, after ignition, is no longer acted on by acid menſtrua.

b) But if the earth be heated to redneſs upon charcoal, it firſt becomes reddiſh, and then of a ſlate-blue. By this treatment it alſo fuſes into an ill-ſhaped globule, which, after refrigeration, preſents a finely radiated ſurface. However, this melting is effected, perhaps, only by a ſmall portion of alkali, which ſtill adheres to the earth.

c) The ſame earth, when fuſed upon charcoal, with a neutral phoſphat and *borax*, or with *ſoda*, in the ſmall ſpoon, yields the ſame reſults as does the rough foſſil, when treated with theſe fluxes. (A. c. d. e).

d). This white earth, alſo, mixed and conveyed with a proper *enamel-flux*, upon porcelain, and baked, produced a pure ſtraw-yellow colour, of a good body. This colour was likewiſe obtained by the raw mineral.

e) At laſt I attempted to reduce it to the reguline ſtate. For this purpoſe I blended 60 grains of the white earth, ignited, with 30 grains of pulverized *colophony* (the reſidue after the diſtillation of the etherial oil from turpentine), and cauſed this laſt to burn away by means of a gentle fire. No ſooner had the flame ceaſed, than the earth appeared

peared again as white as before. It was next divided into two parts. The one half of it was mingled with 20 grains of pulverized white glaſs and 10 grains of calcined borax, and incloſed together in a crucible made of charcoal. The other half was introduced—alone—into the cavity of the charcoal-crucible, covered only with a mixture of glaſs and borax. Both crucibles, well ſecured, were then put into the porcelain-furnace; and both afforded the ſame product; which conſiſted of an irregularly fuſed ſlag, or ſcoria, browniſh at top, light-blueiſh-green below, and of a finely poroſe fracture, with ſome detached large air-holes, the interior ſides of which ſeemed to be confuſedly ſtriated.

This foſſil, therefore, belongs to thoſe *metallic ſubſtances* which appear to be incapable of being exhibited in the ſtate of a fuſed metallic bead.

F.

The ſum of theſe reſults furniſhes ſeveral arguments, upon the ſtrength of which I do not ſcruple to conſider the *red ſhörl*, as it has been hitherto called, of *Boinik in Hungary*, as a natural *metallic oxyd*. The phenomena, upon which I ground my concluſion, are: That the white earth, ſubjected to ignition, becomes yellow, reddiſh, and, in contact with charcoal, blueiſh; that it produces a yellow enamel colour; that it is precipitated from its ſolutions in acids, by Pruſſian alkali, gallic acid, and alkaline ſulphuret; that, when treated in the humid way with tin and zinc, it is recovered in dark flakes, the ſolution then acquiring a red and blue colour; and, laſtly, that it ſhews a very ſtrong tendency to combine with oxygen. It is on account of this laſt property, that the crude foſſil, as being fully ſaturated with that acidifying principle, is inſoluble in acids, and is rendered capable of ſolution only when, by ignition with an alkali, it is deprived of a part of its oxygen. For this reaſon, likewiſe, when I ignited the rough foſſil, in a ſubſequent analytical experiment, with only two parts of vegetable alkali, the earth obtained did not prove ſo white and looſe as that fuſed with five or ſix parts. It alſo diſſolved but imperfectly, in muriatic acid, and not at all in the ſulphuric and nitric.

To theſe facts muſt be added the phenomenon, that the muriatic ſolution of that ſubſtance became changed into a blue tincture by zinc; but when decanted, and expoſed to open air, in a warm place, it again loſt its colour, by imbibing oxygen, and depoſited a white earth.

Another phenomenon, probably the conſequence of ſuper-ſaturation with oxygen, took place when I endeavoured to promote the cryſtallization of a complete muriatic ſolution, by evaporating it in a ſand-bath. This was, that the liquor, which had before been perfectly clear, acquired a turbidneſs and reſemblance to milk, by the heat: nor could it any more be rendered a limpid ſolution by the freſh addition of acid.

It is ſufficiently ſhewn, by ſeveral of its properties, that this metallic ſubſtance does not belong to any of thoſe at preſent known, but rather deſerves to be reputed a new, peculiar genus of metals. Among theſe, the copious *brown-red precipitate*, produced by the gallic acid, furniſhes an eaſy teſt and ſpecific means of diſtinguiſhing it from other metals.

We are yet to give this new metallic ſubſtance an appropriate name.

[illegible] be found for a new foſſil which [illegible] characteriſtic properties (in which [illegible] preſent), I think it beſt to chooſe [illegible] means nothing of itſelf, and thus [illegible] erroneous ideas. In conſequence of [illegible] of the Uranium, I ſhall borrow the [illegible] ſubſtance from mythology, and in [illegible] *Titans*, the firſt ſons of the earth. I [illegible] new metallic genus TITANIUM*; of [illegible], mineralized by oxygen, or *oxyd of* [illegible] the *firſt*, *but perhaps not the only ſpecies*, [illegible] by the following eſſay.

[illegible] *Menachanite*, by *Kirwan*, Mineralogy, vol. [illegible], is the ſame, or analogous to Klaproth's [illegible] *Principles of Modern Chemiſtry*, 1800. Lond. [illegible].—Tranſl.

XV.

CHEMICAL EXAMINATION

OF

A NEW FOSSIL, from the Diſtrict of Paſſau.

AMONG the various and hitherto unknown cryſtallizations of ſome foſſils, which profeſſor *Hunger* has diſcovered in the biſhopric of Paſſau, and whoſe external characters he has deſcribed[*], there is one particularly remarkable, as even its conſtituent parts are not yet known.

The cryſtals of that foſſil are ſmall quadrangular rhombic columns, of a reddiſh, greyiſh, and blackiſh-brown colour. Their ſize varies from $\frac{1}{48}$ to $\frac{1}{4}$ of an inch. Their lateral facets are joined alternately, under angles from 135 o 45 degrees. Both their ends form very ſharp angles; and the inclining ſides iſſue from the obtuſe lateral edge. Their ſurface is ſmooth and reſplendent. Their croſs-fracture is dim, but their longitudinal fracture exhibits a middling luſtre. The ſmalleſt cryſtals of that mineral, and ſometimes its edges, are tranſparent; but it is often totally

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[*] *Beobachtungen und Entdeckungen aus der Naturkunde.* 5ter. Band, 2tes St. Berlin, 1794.

[illegible] are brittle, and eaſily friable, [illegible] hardneſs when grinding, and [illegible] powder.

[illegible] ſeveral places in the neighbourhood of [illegible] though ſeldom, in the *Innviertel*, in Ba- [illegible] cryſtals almoſt always occur diſperſed in a [illegible] grained ſtony matter, the predominant [illegible] conſiſts of a greyiſh, or greeniſh-white fel- [illegible] with hornblende, quarz, mica, ſemi-indurated [illegible] which ſometimes all together are united with [illegible] times, only one or two[*].

A.

[illegible] gravity of this foſſil is 3,510.

[illegible] when ignited upon charcoal, before the [illegible] no remarkable change, except that here [illegible] bubbles were produced on their ſur-weight was diſſolved. This ſolution had a ſtraw-yellow colour; and the addition of cauſtic ammoniac, in exceſs, afforded a precipitate, whoſe appearance and conſiſtence reſembled paſte made of ſtarch; but which, when dried and ground, exhibited a looſe, yellowiſh powder. The remaining fluid contained, alſo, ſome *calcareous earth*, which I precipitated from it by carbonat of ſoda.

What remained, after the extraction by means of the acid, I ſubjected to ignition, together with four times its weight of mild alkali, prepared from tartar. It was next ſaturated to exceſs, and digeſted with muriatic acid, and filtered. *Siliceous earth* was then left behind on the paper. Cauſtic ammoniac threw down from this ſolution a precipitate perfectly reſembling the foregoing; to which, therefore, it was added.

The external appearance of this precipitate led me to ſuſpect in it the preſence of aluminous earth, impregnated with iron. However, it was not found to be ſo upon farther examination: for, after I had again diſſolved it in muriatic acid, and once more precipitated it from this laſt ſolution, the cauſtic alkaline lye, with which the precipitate was digeſted after edulcoration (while yet in a pulpy ſtate), would diſſolve only a very trifling portion of it.

I then fuſed, with glaſs of borax, a ſmall portion of the precipitate, again waſhed and dried; and obtained a ſmall topaz-yellow glaſs-globule. Another portion, fuſed with phoſphoric ſalt, produced one of a pale amethyſtine colour.

Again; another ſmall portion of it, which was diſſolved in dilute ſulphuric acid, ſhewed no ſenſible taſte of alum, and dried to a whitiſh maſs, without ſhooting into cryſtals.

The

The remainder of that precipitate I re-diſſolved in muriatic acid, and treated the ſolution with the following teſts, or re-agents.

Pruſſian alkali produced a dark-green precipitate.

Gallic acid afforded a precipitate of a lively brown-red colour, but paſſing into a pale yellow-red, as it cooled.

A little ſtick of zinc was immerſed into that part of the ſolution which yet remained; and a ſubtle greeniſh-black ſlime was obſerved ſettling around it, at the ſame time that the ſolution itſelf aſſumed the colour of amethyſt. The fluid again loſt that colour after ſome days, and white, flocculent particles, mingled with the ſlime, fell down.

B.

Guided by theſe previous obſervations, I proceeded to the following new experiment.

a) *One hundred grains*, finely ground, were ſubjected, for one hour, to ignition, with a quadruple weight of cauſtic alkali. The maſs, ſoftened by water, yielded a weak graſs-green ſolution; but this colour diſappeared again, as ſoon as more water was added a-freſh. Upon digeſting it with muriatic acid, added to exceſs, and ſubſequent filtration, *ſiliceous earth* was left behind, which, when ignited, amounted to 12 grains.

b) The diſſolved part was next precipitated, by means of carbonated pot-aſh. Upon the dried precipitate, I added a new portion of muriatic acid, and a notable ſmell of oxygenated muriatic acid gas was emitted. During the

di—

digeſtion, there again ſeparated ſome *ſiliceous earth*, the quantity of which, after ignition, amounted to 23 grains.

c) At this time, I combined the ſolution with cauſtic ammoniac., The yellowiſh-white precipitate, obtained thereby, weighed 62 grains, upon deſiccation. One *fourth* part of it, heated to redneſs, was found to weigh 8¼ grains; whence its whole quantity makes 33 grains.

d) To the remaining fluid, mild vegetable alkali has been added, at a boiling heat. It thereby yielded *calcareous earth*, to the amount of 33 grains, when ignited.

C.

Having, in this manner, diſcovered the proportion of the conſtituent parts, I next examined, a ſecond time, the precipitate obtained (B. c.).

a) When ignited alone upon charcoal, it turned browniſh-yellow, and, at laſt, blackiſh.

b) By fuſing it with *borax*, a tranſparent globule of an hyacinthine colour was produced.

c) *Phoſphoric ſalt* did not diſſolve it, but only divided it minutely. If any trace of manganeſe had remained in this precipitate, it would have manifeſted itſelf by a faint amethyſt-colour, with which it tinges phoſphoric glaſs.

d) The portion diſſolved in acids was thrown down by *tincture, or acid of galls*, of a lively, brown-red hue.

e) *Pruſ-*

) *Pruſſiat of pot-aſh* afforded with it a green precipitate, ning to brown, and thereby reſembling ſap-green. is, however, when dried, appeared again with its original en colour. The liquor, ſeparated from it by filtration, s not altered by re-agents.

) The addition of *ſulphuret of ammoniac*, prepared after ann's manner, produced a flocculent precipitate, of a k muddy-green.

) *Phoſphoric acid*, as well as

) *The acid of arſenic*, produced a white precipitate.

) Laſtly, this precipitate, when combined with a proper antity of enamel-flux *(glaſs-paſte)*, and thus laid upon celain, and fuſed, gave to its ſurface a *yellow* colour, ging to brown.

Therefore, ſince theſe reſults not only indicate, in an

Silex	B. *a*)	12	35
	b)	23	
Lime	*d*)		33
Oxyd of Titanium	*c*)		33
Manganeſe, a ſlight trace.			
			101

Now, what place ought to be aſſigned, in the mineralogical ſyſtem, to this new foſſil? Since mineralogiſts are not yet agreed as to the principles, according to which the ſyſtem of mineralogy ſhould be arranged, thoſe who direct their principal regard to the *ſpecifical* conſtituent part, will readily claſs the *Titanite* as a *ſecond ſpecies* of the *Titanium genus*. Such, on the contrary, as inſiſt more ſtrictly on the predominant part, with regard to quantity, will, perhaps, decide for its inſertion under the head *ſiliceous genus*.

XVI.

EXAMINATION

OF THE SUPPOSED

MOLYBDENOUS SILVER.

[illegible] a metallic foſſil was met with at [illegible] Comitatus Hontenſis, in Hungary, [illegible] introduced as a new ſpecies of ſil- [illegible] following deſcription of it *.

ARGENT MOLYBDIQUE.

[illegible] with ſulphurated Molybdena.

[illegible] *alloy of ſilver with ſulphurated* [illegible] *till now unknown. It is no where* [illegible] Deutſch-Pilſen *in* Hungary, *where it* [illegible] *kidney-form nodules* (rognons), [illegible] *in thickneſs, enveloped in a common* [illegible] *nodules ſeparate in pretty large and* [illegible] *admit of a new diviſion into ſmaller* [illegible] *ſulphurated molybdena, and* [illegible] *grey traces. By cupelling this* [illegible] *there are obtained 23 mares of ſil-* [illegible] *centner.*"

[illegible] ſcarcity of this mineral, few che- [illegible] opportunity of examining it, I under- [illegible] readily: and I found by theſe re- [illegible] neither *ſilver*, nor *molybdena*, and [illegible] *mineralized by ſulphur* *.

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* [illegible] de la Collection des *Foſſiles de Mlle de Raab-* [illegible]

A.

a) If this ore be tried *per ſe* upon charcoal, with the aſſiſtance of the blow-pipe, it runs into a globule, as ſoon as it comes in contact with the point of the flame. That globule may be gradually blown off by means of the bellows, in which caſe it gives out a metallic vapour, which in part ſettles on the coal, of a yellow colour. But if borax, or a neutral phoſphat, be added, it ſeparates from the melting ſaline pearl, and leaves the latter colourleſs behind it.

b) *Twenty-five* docimaſtic pounds of this ore † ſubjected to cupellation under the muffle, with four times their weight of lead, left behind them a globule of ſilver, only viſible by the microſcope; but this, undoubtedly, muſt have been furniſhed by the lead.

B.

a) Upon *fifty* grains of the triturated ore I poured moderately ſtrong nitric acid. It was immediately attacked and diſſolved by it, with extrication of red vapours; and the reſiduum conſiſted of 2½ grains of ſulphur.

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* That I may not be ſuſpected of having beſtowed my labour not upon the genuine *argent molybdique* of *Born*, I here declare, that the ſpecimen which I examined was a fragment of the very individual piece, of which Born has deſcribed the above external characters.

† About 24⅝ drachms *Troy-weight*. The German docimaſtic center, or one drachm, is equal to 72 *French* grains of the former *poid de marc*, which correſpond to 59,0677 *Engliſh grains Troy*. Tranſl.

[illegible] ſolution with a large quanti- [illegible] the mixture inſtantaneouſly al- [illegible] and depoſited a fine, white, [illegible] of pure *oxyd of biſmuth.*

[illegible] filtration was mixed with mu- [illegible] firſt perfectly clear, but gra- [illegible] what milky; and at the bottom [illegible] ponderous precipitate, the dazzling [illegible] not the leaſt change by the [illegible] merely *oxyd of biſmuth.* Had [illegible] of muriated ſilver, however [illegible] diſcovered itſelf by tarniſhing the [illegible] precipitate, on expoſure to the light of

[illegible] parts of this ore contain:

[illegible]	95
[illegible]	5
	100

[illegible] of ſulphur, it ſeems that the [illegible] mineralized; hence that ore [illegible] bismuth. And probably on [illegible] its whiter colour, and brighter [illegible] reſembles that of ſilver recently po- [illegible] it is diſtinguiſhed, in external cha- [illegible] ſulphurated biſmuth of *Riddarhyttan*, [illegible] which is more of a lead-grey colour.

XVII.

XVII.

EXAMINATION
OF THE
NATIVE ALUMINOUS EARTH
FROM SCHEMNITZ.

IN the pit called *Stephani-Schacht*, at *Schemnitz*, in *Hungary*, an earth was lately dug up, which is there reckoned to be aluminous earth, naturally quite pure and free from ſilex. It is as white as ſnow, light, crumbling, very friable; it ſtains but moderately, and adheres to the tongue*.

I put this earth to the trial in the following manner:

a) *One hundred* grains of it were expoſed to a ſtrong red heat for one hour in a covered crucible. After refrigeration, I obſerved in it a loſs of weight of 42 grains; which, it is obvious, was only the weight of the particles of water driven out by the fire. No alteration was effected by this in the exterior appearance of the earth; except that the pieces were made a little rifty, and diminiſhed in ſize.

b) Another *hundred* grains of this earth were gradually conveyed into dilute ſulphuric acid. They diſſolved in it without efferveſcence, yet accompanied by an obſervable diſengagement of caloric. The ſolution proved perfectly limpid; but upon evaporation it formed a clear and tranſparent coagulum, the ſurface of which, after a few days, appeared to be covered with a quantity of ſolitary, pyramidal, cryſtalline ſhoots. The maſs was next drenched

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* A fuller deſcription of it has been given by *Fichtel*, in his *Mineralogiſche Aufsätze*. Vienna, 1794. page 170.

and

d digeſted with an abundance of water; and then *ſiliceous* *rth* ſeparated, weighing 14 grains, when collected by tering, and ignited.

c) When the ſolution, thus freed from the ſilex, had en combined with the requiſite portion of pot-aſh, and yſtallized, it afforded pure alum; from which the aluminous rth was afterwards precipitated by means of pot-aſh, and rified in the manner frequently mentioned.

Hence the diſcovered conſtituent parts of this earthy foſ- amount to:

Ignited Alumine . .	c)	45
Silex	b)	14
Aqueous particles loſt by ignition		42
		101

The chemical knowledge of this earth is chiefly remark- e on this account, that hitherto, with the exception of ne gems, no other mineral ſubſtance has been known, ich conſiſts of alumine and ſilex in ſuch proportions that

XVIII.

CHEMICAL RESEARCHES

INTO

STRONTIANITE,

COMPARED WITH

*WITHERITE**.

SEVERAL properties, which *Strontianite* has in common with thoſe of *Witherite*, ſeemed to juſtify its being taken, when firſt diſcovered, for a ſpecies of the native carbonat of barytes. However, by the circumſtance of paper, dipped in a nitric ſolution of ſtrontianite and dried, burning with a red flame, I was induced to conjecture, that this foſſil might, perhaps, be diſtinguiſhed from witherite by other properties. This ſuppoſition was ſtrongly ſupported by the reſult of the chemical examinations inſtituted by *Sulzer* upon this ſubſtance, as well as by the experiments which *Blumenbach* has made upon animals.

It was probably the difficulty of obtaining ſtrontianite in ſufficient quantity, that has prevented the repetition and confirmation of thoſe experiments; in conſequence of this, the preſent additional eſſay, tending to procure a more accurate knowledge of it, may be deemed not ſuperfluous.

But in order the better to compare the properties and chemical relations or habitudes of ſtrontianite compared

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* *Chemiſche Annalen*, 1793. 2 B. page 189. and *ditto*, 1794. 2 B. page 99.

with

witherite, I have thought it proper to place the reſults of an examination into each.

theſe foſſils belong to thoſe products of nature, been diſcovered only within the laſt ten years.

The place at which the *ſtrontianite* was found the time is *Strontian*, in *Scotland*; where this foſſil breaks vein of lead, together with ponderous ſpar (ſulphat of in a mountain chiefly conſiſting of gneiſs*. It is maſſive, in oblong coarſely fibrous pieces, accumu- in bundles. It is of a light green, a little tranſpa- ſhining, and moderately hard.

ſpecific gravity I found to be 3,675.

According to the experiments which *Blumenbach* has with regard to the effects of ſtrontianite upon animal it was found to poſſeſs nothing of the deleterious pro- of witherite; as the former was eaten by animals injury.

continued for ſome time miſunderſtood, was the concealment practiſed by the miners of that place, who, from its weight, ſuſpected it to contain ſome noble metal; and perhaps alſo to the baſe intereſtedneſs of the uſurious dealers in foſſils.

The colour of witherite is grey-white. It uſually occurs in conſiderable maſſes, and only occaſionally in ſix-ſided priſms, terminated by hexahedral pyramids. Thin fragments of it tranſmit the light. Its longitudinal fracture is gloſſy, and feebly ſtriated; but its croſs-fracture is only glittering and uneven. Its hardneſs is but middling; and its ſpecific gravity is 4,300, and therefore more conſiderable than that of ſtrontianite.

A ſecond place at preſent known, where native carbonat of barytes occurs, is the *Schlangenberg*, in *Siberia*. There it is met with of a grey-white colour, in the form of a ſtalactitical incruſtation, reſembling chalcedony.

FIRST EXPERIMENT.

a) *One hundred* grains of *ſtrontianite* in coarſe fragments, and put into a porcelain-veſſel, were ignited during the ſpace of two hours in a wind-furnace. Their figure was not ſenſibly altered by this; but their bright-green colour, their luſtre, and tranſparency, were deſtroyed. On weighing them, while yet hot, I obſerved a loſs of weight of no more than half a grain; and this loſs ſeems to be merely that of the moiſture expelled.

This experiment I repeated with another 100 grains; but expoſing them for five hours to a fire of ſuch intenſity, as to be capable of converting white marble into quick-lime, in but half that time. By this much ſtronger and more laſting

with thoſe of witherite, I have though
together the reſults of an examination i

Both theſe foſſils belong to thoſ
that have been diſcovered only withi

a) The place at which the *ſt*
firſt time is *Strontian*, in *Scotla*
in a vein of lead, together with
barytes), in a mountain chiefly
found maſſive, in oblong coar
lated in bundles. It is of a
rent, ſhining, and moderatel

Its ſpecific gravity I foun

According to the expe
made with regard to the
life, it was found to poſſe
perties* of witherite; a
without injury.

b) The *witherite*,
in the lead-mines at
gether with the folia
or earthy matter,
miners and inhabi
acquainted with
ſtone, as containi
why the geogno
witherite (falſel

---

* This mou
ſtony matter
ther to be g

---

n by f
hat of fre
were put aſi
minutes it was a
icle; which con
ſoon as the precedin
thereby cauſed to ſ
more was produced,
ey weighed ſeven grain
alkali was then added t
been boiled with burn
me milky, and depoſite
e pulverulent ſtate. Into
I inſtilled ſulphuric acid,
of ſulphat of ſtrontian-earth
third portion of this water
uriat of mercury (corroſive
ediately decompoſed; ſo that
firſt a brown-red, and, upon
orange-yellow-colour.

the violent ignition which
part of ſtrontianite had been
by this experiment; while the
with acids as ſtrongly as the

experiment, I ſubjected *one hun-*
a porcelain-crucible to the ſame
the ſame time of five hours
It

ed thereby, than that its
its tranſparency was
clined to a blueiſh
und to be conſiderably
yet hot. The water,
in the foregoing experi-
from pure water, neither
nts. Corroſive ſublimate diſ-
neſs; and it likewiſe continued
ing ſulphuric acid into it. The
ielded, on the ſubſequent affuſion of
me quantity of carbonic acid gas,
rom it, when in the crude ſtate.

ECOND EXPERIMENT.

d a piece of *ſtrontianite*, of about half an ounce
, to be expoſed, in a clay-crucible, to the moſt
t heat of the porcelain-furnace. When the veſſel
n returned to me, the ſtrontianite was found to
attacked and diſſolved the clayey maſs of the crucible,
to have run with it into a clear chryſolite-green, very
rd, and denſe glaſs.

b) The piece of *witherite*, which, by way of reciprocal experiment, had been expoſed in the ſame manner to the ſame fire, and under the ſame circumſtances, had likewiſe ſtrongly acted on the crucible, and was converted into a hard, greeniſh glaſs, which, however, was not perfectly compact, but held ſome air-bubbles.

I repeated this experiment, but with this variation, that I weighed accurately 100 grains of each of theſe two foſſils; and I alſo exactly noted the weight of the clay-cruci-

s, which had previouſly ſuſtained a violent ignition. By vitrification the *ſtrontianite* loſt 30, and the *witherite* grains; which loſs of weight exactly agrees with the portion of carbonic acid contained in each of thoſe mi-
als, as will appear from the ſequel.

THIRD EXPERIMENT.

) In order to aſcertain the habitudes of *ſtrontianite*, en expoſed to the degree of heat requiſite to the baking porcelain, and debarred from immediate contact with the cible, I inſerted one piece of it, weighing 160 grains, a cavity made in a compact piece of charcoal, and ſed that cavity with a ſtopper, likewiſe made of char-
l. This piece of charcoal was then ſecured in a well d melting-pot, which I ordered to be put upon that t of the porcelain furnace, where the fire acts in the t intenſe degree. Upon opening the pot, which was ught to me from the furnace while yet warm, I found outſide of the coal in part conſumed*, and hence leſ-
ed in its volume; but the middle and inner part was not

had now been entirely deprived, both of its ſlight portion of water, and likewiſe of all its carbonic acid; as will be confirmed by the ſucceeding experiments.

When it had been reduced to powder, and twice boiled with water (one pound of the fluid each time), it entirely diſſolved in it; leaving only an inconſiderable reſidue, which, beſides ſome adhering coal-duſt, chiefly conſiſted of lamellas of carbonated ſtrontian, which was rapidly regenerated.

In the *firſt* of theſe decoctions, which immediately after filtration had been preſerved in a ſtopped glaſs bottle, there appeared cryſtals in half an hour's time, which viſibly increaſed, and formed an exceedingly beautiful group. Theſe cryſtals were clear and tranſparent, of a needle-ſhaped figure, and aggregated in filiform, knit, or interwoven planes. The whole of them bore reſemblance to the cryſtals of muriated ammoniac: or rather, conſidering the moſtly upright and cellularly implicated facets, which are formed by the accumulation of plumoſe cryſtals, it reſembles the native ſilver of Potoſi, dendritically cryſtallized in large laminas.

However, this cryſtallization of calcined ſtrontian-earth in ſimple water, without the acceſs of other extraneous ſubſtances, is on its own account highly remarkable; even without noticing the beauty of its cryſtals. This phenomenon is entirely new, and the firſt inſtance of an artificial cryſtallization of a ſimple earth in mere water.

The *ſecond* decoction of the burned ſtrontianite, that was kept in another glaſs, likewiſe afforded, after a few days, ſome ſolitary cryſtals. Theſe, however, had not the plumoſe appearance of the foregoing, but were minute, oblong, quadrangular plates, ſharpened on the edges.

The water decanted, proved ſtill of a ſtrong cauſtic taſte, and depoſited carbonat of ſtrontian, when carbonated alkali had been dropped into it. The cryſtals themſelves affected the tongue with the like corroſive taſte. By expoſure to air, they turned opake and milk-white. A part of them, immerſed in muriatic acid, diſſolved in it; yet no air at all was developed; and at the ſame moment I obſerved acicular cryſtals of muriated ſtrontian-earth ſhooting in the ſolution.

By treating *witherite*, on ſeveral repeated experiments, in crucibles formed of charcoal, for the purpoſe of depriving it entirely of its carbonic acid, I could never completely ſucceed. That foſſil penetrated, and in ſome manner conſumed the ſubſtance of the charcoal; and it was again found at the bottom of the outer clay-crucible, in a ſtate of ſemi-fuſion.

FOURTH EXPERIMENT.

a) As, in theſe experiments, I had given the preference to muriatic acid, I firſt endeavoured to aſcertain what quantity of it would be required to diſſolve a certain portion of *ſtrontianite*. With this view I mixed 100 grains of muriatic acid, of 1,140 ſpecific gravity, with 50 grains of water, and introduced into this menſtruum pure fragments of ſtrontianite, weighing, in the whole, 62½ grains. After the acid had been fully ſaturated with it, without the aſſiſtance of heat, there remained ſeven grains; hence 55½ grains were diſſolved and ſpent in the ſaturation of the acid. The action of the acid was vigorous, and the ſolution proceeded with a pretty ſtrong efferveſcence. It was neceſſary to weaken the muriatic acid with half its quantity of water, becauſe, when concentrated and alone, it ſhews but a weak operation.

Guided by this experiment, I took a quantity of muriatic acid ſufficient to diſſolve 100 grains of ſtrontianite, and having diluted it with half its quantity of water, I put it upon the balance, and equipoiſed it on the other ſcale, Theſe 100 grains of ſtrontianite were then gradually conveyed into the menſtruum, and thus the weight of the carbonic acid, diſengaged, was found to be 30 grains.

Therefore, *ſtrontianite* contains, in an *hundred* parts,

Strontian earth	69½
Carbonic acid	30
Water	½
	100

b) To find in the comparative experiment, which I intended to make with *witherite*, the proportion of muriatic acid requiſite to its ſolution and ſaturation, I prepared a mixture of 100 grains of muriatic acid with 200 of water; this degree of dilution being neceſſary, to render that acid capable of acting with full energy upon that mineral, and producing a clear ſolution. Into this mixture were then put 76 grains of witherite, in coarſe pieces. The ſaturation of the acid was accompanied by a ſtrong efferveſcence, and only three grains remained undiſſolved. One hundred grains of muriatic acid, therefore, required 73 grains of witherite, to be completely ſaturated; and, conſequently, 17½ grains more of it than of ſtrontianite.

In conſequence of this proportion of muriatic acid to witherite, I now introduced 100 grains of this foſſil into a ſufficient quantity of that menſtruum, which alſo I previouſly brought to an equilibrium upon the balance. When its ſolution was accompliſhed, the quantity of carbonic acid gas eſcaped amounted to 22 grains.

Hence, in hundred parts of witherite are contained,

Barytes	78
Carbonic acid	22
	100

FIFTH EXPERIMENT.

a) If the muriatic ſolution of *ſtrontianite* be in part evaporated by a low heat, the *middle*, or earthy ſalt, will ſhoot in it into fine, longiſh, needle-ſhaped, but often, likewiſe, into larger priſmatic cryſtals, which continue perfectly dry in the air, but readily diſſolve in water.

If, upon theſe cryſtals, a ſufficient quantity of ardent ſpirit, not too much dephlegmated, be poured, and put in a warm place, they are diſſolved by it. The alkohol acquires, by them, the property of burning with a pleaſing carmine-red flame, if printing-paper, cotton, and ſuch looſe bodies are moiſtened with it, and ſet on fire.

b) The muriatic ſolution of *witherite*, on the contrary, yields oblong hexagonal tables of a much more conſiderable ſpecific gravity; and likewiſe theſe cryſtals require a greater quantity of water to be diſſolved than the others. Their ſolution, in weak ſpirit of wine, when ſet on fire, does not ex-least trace of the red colour in the flame, by of ſtrontianite is ſo remarkable. The ardent ns, in this caſe, only with a yellowiſh-white flame.

SIXTH EXPERIMENT.

The ſolution of *ſtrontianite*, in nitric acid, is likewiſe effected. Out of 100 grains of the foſſil employed, ains of carbonic acid gas were diſengaged, as took place the fourth experiment, by means of the muriatic acid. nitrat of ſtrontian, which is afforded by this ſolution, hen brought within a ſmaller compaſs, by a ſlow evaporation, forms cryſtals, which are clear and permanent in the ir, the fundamental figure of which ſeems to be the double quadrilateral pyramid (octahedron), with its uſual variations.

b) Nitric acid, employed for the ſolution of *witherite*, muſt be more liberally diluted with water, to prevent the too rapid formation of the cryſtals, which would otherwiſe take place. Theſe, likewiſe, ſeem to be nearly octahedrons; they are, however, leſs diſtinct, and, in part, more of a tabular figure. They are, beſides, diſtinguiſhed from thoſe of ſtrontianite, by being leſs clear, and by their dull and opake appearance.

SEVENTH EXPERIMENT.

a) By acetic acid *ſtrontianite* is acted upon with little energy. I boiled vinegar, diſtilled and concentrated by freezing, upon finely ground ſtrontianite, and gently evaporated the liquor filtered off from the undiſſolved reſidue. It afforded ſmall and clear cryſtals, that did not deliqueſce in the air, and the figure of which appears to conſiſt of thin rhombic tables.

9 *b*) Ar

conſequence of this propor[illegible] prepared in the ſame ite, I now introduced 100 [illegible], a tenacious con- nt quantity of that menſtru[illegible] a maſs, reſembling t to an equilibrium upon [illegible] ther ſolution of this was accompliſhed, the qu[illegible] aneouſly in a ſhallow amounted to 22 grain[illegible] ved to have cryſtallized [illegible] d dendritic figures of a ce, in *hundred* parts [illegible] peaking, it dried in that [illegible] had been rediſſolved in [illegible] *Barytes* [illegible] and permanent cryſtals, [illegible] *Carbonic* [illegible] columns, obliquely trun- [illegible]

FIFTH [illegible]*ERIMENT.*

[illegible] ized *ſtrontianite*, introduced [illegible] two ounces of concentrated f the muriati[illegible] that was affuſed cauſed a y a low he[illegible] of the retort were then fine, long[illegible] days after, the greateſt part of this cryſtalline maſs, of very tender fibres. alſo immediately decompoſed by the addition, and ſulphat of barytes precipitated.

NINTH EXPERIMENT.

mpoſed a ſolution of 100 grains of *ſtrontianite* acid, previouſly diluted with ſufficient water, of mild vegetable alkali. The earth again took the precipitating medium that quantity of carbonic of which it was deprived during its ſolution in the atic acid. When edulcorated and dried, it again appeared with its former weight of 100 grains.

b) *Witherite* exhibits the very ſame habitude in this point. From 100 grains of it, diſſolved in that acid, and afterwards precipitated by carbonat of pot-aſh, I likewiſe recovered 100 grains.

TENTH EXPERIMENT.

It is, however, to be obſerved, that in theſe combinations of the reſpective earths of the *ſtrontianite* and *witherite* with carbonic acid, made by art, this laſt conſtituent part is not ſo obſtinately retained by them in a read-heat, as it is when both exiſt in their natural ſtate.

a) For, when I expoſed 100 grains of precipitated *ſtrontian-earth* to intenſe red-heat during two hours, when upon this I boiled it in two ounces of water, and triturated two grains of corroſive ſublimate, with the water filtered off from that decoction, the mercurial oxyd would not diſſolve in it, but ſeparated of a yellow-brown colour.

XIX.

AL EXAMINATION

OF

IDOLITE.*

otice, by the name *Lilalite*, was
gypfum, and then for a ſpecies of
publiſhed of it is that of *Born*,
1791, B. 2. S. 196, where he writes

here are found, between blocks
large and heavy maſſes of a
texture, like that of the aven-
ing lamellas, that, at the firſt
as micaceous particles. But
veſtigation, are found to be
mellas of zeolite, having the
earl. When ignited between
ing. In a ſtrong fire it runs
reſembling wax. At an in-
ppears, which laſt ſeems to
Some pieces of this foſſil are
ers are traverſed by granite;
perfectly pure, and its chief

---

* der *Naturkunde*, vol. v.

To this deſcription, given by *Born*, I may add, that the hardneſs of this ſtone is but inconſiderable, as it may be ſcraped with the nail of the finger. Notwithſtanding this, it is capable of ſome poliſh when cut into plates.

Its ſpecific gravity is but middling, viz. 2,816 *

The opinion of thoſe, who thought it to be a ſpecies of gypſum, (ſulphat of lime) I found totally unſupported. But how juſtly this foſſil may be ranked with the zeolites, will be underſtood from the reſult of the preſent analyſis, the ſubject of which was its amethyſt-red variety.

A.

a) When this foſſil is heated to redneſs upon charcoal, before the blow-pipe, it firſt frothes up moderately, but ſoon after it runs into a perfectly fuſed milk-white pearl, which, in moſt of its parts, is tranſparent; but, if broken by the hammer, yields fragments entirely clear.

b) By a neutral phoſphat it is gradually diſſolved, and then it fuſes into a ſemi-tranſlucid white pearl.

c) Vitrified boracic acid (glaſs of borax) diſſolves it more readily, and fuſes with it into clear colourleſs ſpherules.

d) On melting it with ſoda, in the ſilver ſpoon, it moderately boils, and a maſs, ſpeckled red and blue, is produced.

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* The external characters of Lepidolite are deſcribed by *Karſten*, loc. cit. pag. 71.

CHEMICAL

LE

THE foſſil brought
firſt taken for a ſpecie
Zeolite. The firſt
in the *Chemiſche Ann*
of it as follows.

"At *Rozena*, in
"of granite,
"denſe violet
"turino, exhibit
"view, might b
"theſe, on mor
"nothing elſe
"luſtre of the
"coals, it fuſ
"into a denſ
"creaſed heat
"originate fr
firmly implant
but, for the
conſtituent

---

* *Beobacht*
1 St. S. 59.

---

cible, for half an
and that of a light

ed foſſil, mixed with
were expoſed to a
crucible, for two hours
a conſiderably firm
vessel before cooling,
ſome parts an amethyſt
it, after grinding, be-
A few drops of nitric
roſe-red. But as ſoon as
it immediately deſtroy-
under examination, was
of colour, therefore, in-
foſſil is owing to a pec-

with muriatic acid, added
ſoluble parts was aſſiſted by
exhibiting a bright yel-
the *ſiliceous earth* by filtra-
much inflated, and, when
weighed 212 grains.

had been concentrated, by
ſited ſome *ſiliceous earth*,
ition. By its ſubſequent

---

dolite, in the fire of the
Eſſay.

combi-

uſſian alkali, a dirty blueiſh precipitate,
ent form, was thrown down, which, upon
ſidue of four grains, conſiſting of inter-
own and grey-white particles. This re-
if at all, attracted by the magnet. When
oſphated alkali, it formed a milk-white
cid pearl. Glaſs of borax gave it firſt a green,
net red colour. Soda produced with it a black
ich, with the help of the microſcope, extremely
er-white metallic globules could be ſeen.

ortion of iron that was contained in the quantity
ated pot-aſh, requiſite to effect that precipitation,
ne grain; which being ſubtracted, there remain
ains for the iron and the mangeneſe, conſtituting the
contents of the ſtone.

now mixed the ſolution with cauſtic (pure) ammo-
A copious precipitate, in the form of flour-paſte, fell
which I directly ſeparated by filtering. When
ted, dried, and expoſed to gentle red-heat, it was
he aluminous earth, of 152 grains in weight.

he fluid remaining, after the ſeparation of the argil,
bined with carbonated alkalis; but no new precipi-
ted. Therefore, I evaporated the liquor to dryneſs,
again the ſaline maſs in water, and collected the
ortion of earth which then ſeparated. It weighed
ains, conſiſting of two grains of *ſilex* and one grain
ne.

above decompoſed 400 grains of the foſſil, there-
ſted:

Ignited

Ignited *ſilex*	B. *b*)	212	218 g
	c)	4	
	e)	2	
Alumine	*d*)	152	153
	e)	1	
*Mangan*e*ſe* and oxyded *iron*	*c*)		3
			374

Which gives for *one hundred* parts,

Silex	54,50
Alumine	38,25
Manganeſe and *oxyd of iron*	0,75
	93,50
Loſs in *aqueous particles*	6,50
	100

C.

As the fuſibility of lepidolite, without addition of extraneous ſubſtance, induced me to ſuſpect, that, am its conſtituent parts, ſome *calcareous earth* might be fo I reſolved to repeat its analyſis.

For this reaſon, I again ſubjected 400 grains of it to ſame analytical proceſs. Having ſeparated the ſiliceous ea the quantity of which was the ſame in proportion with of the firſt proceſs, I treated the ſolution, then obtai with mild vegetable alkali, and at a raiſed temperature. precipitate produced in the proceſs, and waſhed, was di ed into four equal parts while yet moiſt.

a) Upon one fourth part I affuſed *dilute ſulphuric a* which ſoon diſſolved it into a weak reddiſh liquor. Aft ſhort repoſe, a reddiſh-grey ſediment fell down, which, carefully collected and dried, weighed half a grain, and readily fuſed upon charcoal to a black-grey ſcoria. When a ſmall portion of this laſt had been thrown into melted phoſphoric ſalt, it gradually diſſolved, and gave a green tinge to the ſaline bead. But when the whole of it was put in, the ſmall globule loſt its tranſparency and aſſumed a blue colour. At the ſame time a very minute grey-white metallic grain became diſcernible, which, when ſeparated from the ſpherule, would not obey the magnet. As that metallic bead hardly weighed $\frac{1}{32}$ of a grain, it would not admit of farther inveſtigation. Perhaps it was *phoſpat of iron.* The ſaline bead, by imbibing moiſture, was again diveſted of its blue colour, and turned brown-red.

The ſulphuric ſolution, left in a colourleſs ſtate, after the ſeparation of the above depoſition, was committed to ſpontaneous exhalation; and it then ſhot, by degrees, into perfect cryſtals of alum. At laſt there remained a thickiſh reſidue, which, previouſly diluted with water, and warmed, I combined with vegetable alkali. A ſlight quantity of a looſe, whitiſh precipitate fell down of $\frac{1}{3}$ grain in weight, when edulcorated and dried. By expoſure to air, it acquired a brown colour, and by ignition upon charcoal it became black. Treated with a neutral phoſphat, with the aſſiſtance of the blow-pipe, it ſoon melted to a ſmall globule, which, by turns, appeared colourleſs, when acted on by the inner flame, and amethyſt-red, by the outer-flame. Thus it proved to be *mangane ſe.*

b) Upon another fourth-part of the precipitate, vinegar, diſtilled and concentrated by freezing, was affuſed, and decanted again from it, after 12 hours. In order to try this acetous liquor for calcareous earth, it was divided into three parts, each of which was ſeparately treated; one, with

[illegible] *of pot-aſh*; the third with *ſal-*
[illegible] any indication of lime was ob-
[illegible] remaining perfectly clear. The
[illegible] contained ſome of argil, which I
[illegible] potaſh.

[illegible] of the precipitate, likewiſe before
[illegible] into heated *cauſtic alkaline lye*: it
[illegible] a ſmall browniſh reſidue, conſiſting
[illegible] metallic ingredient of the ſtone, to-
[illegible] trace of ſilex.

[illegible] remaining fourth-part of the yet moiſt pre-
[illegible] completely to deſiccate in a warm place.
[illegible] a milk-white, and weighed 54 grains. It
[illegible] its colour, and but little of its bulk, by a
[illegible] or two hours in a ſmall and covered crucible.
[illegible] was the more diminiſhed, as it then weighed

metallic portion is too ſmall to be capable of being conſidered, with any degree of probability, as the cauſe of the fuſibility of this foſſil.

Is there, perhaps, in thoſe argillaceous ſtones that fuſe in the fire, without any admixture either of abſorbent earths or of metallic calces being found in them, ſome hidden principle, promoting their fuſion, which is hitherto unknown, and is of a volatile nature? Fel-ſpar affords an inſtance of them. This ſtone, while continuing in its natural unaltered ſtate, runs into a glaſs; whereas porcelain-clay, which reſults from its decay, is infuſible in the higheſt degree. Therefore, it might not ſeem unreaſonable to ſuppoſe, that during this tranſition of vitrifiable fel-ſpar into infuſible clay, ſome volatile ſubſtance, as yet unknown, and capable of promoting fuſion, might eſcape; did we not, on the contrary, find, by experience, that vitrified fel-ſpar, if again expoſed to fire, enters again into fuſion, in the ſame manner as it did the firſt time.

It remains yet to inveſtigate, whether the lepidolite is juſtly ranked, as *Born* would have it, among the zeolites. When we attempt, in the mineralogical ſyſtem, to ſeparate and to determine the various ſpecies of foſſils, not in a vague manner, but according to fixed characters; the queſtion is, then, in which of its properties does the ſpecifical character of zeolite conſiſt? I think, in the following: that it is moderately hard, and gives no ſparks with ſteel; that, urged by the flame upon charcoal, it is rendered milk-white and opake, ſwelling much at the ſame time, and forming ramoſe excreſcences, yet without actually fuſing into a globule; and that, beſides the ſiliceous and aluminous earths, the calcareous, likewiſe, is an eſſential conſtituent part of it. The mother-of-pearl-like luſtre, the gelatinous coagulum, which it forms with acids, and its phoſphoreſcent

lic acid; another, w
ric acid. But in ... confidered as any of its eſſen-
vable; all theſe th
tous ſolution m
cipitated from t ... foſſil does not ſhew the
... as the zeolite, but as it

) The third ... at the ſame time, it fuſes
ing, was in ... pellucid, round globule; and,
uefied in it, ... deſtitute of lime for one of its
the above ... afford ſufficient ground to
her with ... in the ſyſtematical arrangement
... a diſtinct ſpecies.

) Laſſ
tate I ... ubts whether the name *Lilalite*,
e eart ... introduction into public notice,
nothi ... I recommended, in its ſtead, the
ng i ... ſcale-ſtone), for its *ſpecific name*;
its ... its fracture like an aggregate of
g

ſtals, longitudinally ſtriated, and tranſverſing grey-white rz, and occurs, with various degradrations, of a pale- colour, in ſome ſpecimens paſſing into the iſabella, and o green. This mineral was pretended, by ſome, be *cryſtallized lilalite:* but, even without having yet formed a perfect analyſis of it, I am already convinced, t it by no means belongs to that foſſil, but to the *ſhör-* *eous beryl*, (ſhörlite,—by Kirwan); with which it agrees t only in its extarnal appearance, but alſo in its habi- les, in the dry way.

XX.

CHEMICAL EXAMINATION OF *CIMOLITE.*

THE *Cimolic earth* (Cimolia Plinii), or the *Cimolite*, as I ſhall call it for the ſake of brevity, belongs to thoſe bodies of the mineral kingdom, of which an hiſtorical knowledge has, indeed, reached our age, from the writings of ancient claſſics, ſuch as *Theophraſtus*, eſpecially, *Dioſcorides* and *Pliny*; but a familiar acquaintance with them has gradually been loſt ſince the time of thoſe authors. We learn from the works of thoſe old naturaliſts, that the Greeks, as well as the Romans, beſides its medical uſe, employed the cimolic earth for technical purpoſes, in the preparation and cleaning of their ſtuffs and wearing apparel. This is ſhewn, among others, in the following paſſage of Pliny*:—*Cretæ plura genera. Ex iis* Cimoliæ *duo ad medicos pertinentia: candidum et ad purpuriſſum inclinans.* And having firſt mentioned its various applications in medicine, he thus continues: *Eſt et alius uſus in veſtibus. Nam ſarda, quæ adfertur e Sardinia, candidis tantum adſumitur, inutilis verſicoloribus: et eſt viliſſima omnium Cimoliæ generum. Pretioſior* Umbrica, *et quam vocant* Saxum.—*Primum abluitur* veſtis Sarda, *dein ſulphure ſuffitur: mox deſquamatur Cimolia, quæ eſt* coloris veri. Fucatus *enim deprehenditur, nigreſcitque, et funditur ſulphure.* Veros *autem et* pretioſos colores *emollit Cimolia, et quodam nitore exhilarat contriſtatos ſulphure.*

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* Hiſt. Natural. lib. xxxv. chap. lvii.

What later writers have mentioned concerning cimolite (*Agricola*[*], for inſtance), are mere compilations taken out of thoſe ancient authors. *Tournefort*, however, is to be excepted, who certainly ſaw it in his travels through the Levant, but has erroneouſly taken it for an earth of the calcareous kind, diſtinguiſhed from common calcareous earth, as he thought, by its ſoapy fatneſs.

It is by the kind communication of *John Hawkins, Eſq.* who, in his voyage to the Grecian iſlands, made for the advancement of Natural Hiſtory, has collected the genuine cimolic earth on the iſland *Cimolo* itſelf, or *Argentiera*, as it is called at preſent, that I have been enabled to revive the knowledge of this foſſil, hitherto loſt both to Natural Hiſtory and Technology, and, at the ſame time, to undertake its chemical analyſis.

The *colour* of cimolite is a light greyiſh-white, inclining to pearl-grey. But this colour is ſomewhat changed by expoſure to air, where it acquires a reddiſh tint. It is, therefore, probable, that the *cimolia ad purpuriſſum inclinans*, of *Pliny*, as well as his *candida*, are both one and the ſame ſpecies; ſince the firſt, or the externally reddiſh one, is, on the fracture, as white as the ſecond.

Cimolite is found *maſſive*, and probably it occurs in vaſt ſtrata. Its fracture is *earthy*, *uneven*, and its texture more or leſs *ſlaty*. It is thoroughly *opake*, and does *not ſtain*

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[*] *De Natura Foſſilium*, lib. ii.

con-

e) I now combined the ſolution with Pruſſian which produced a deep-blue precipitate; by the quan which the proportion of the ferruginous ingredient, form of *oxyd of iron*, attractible by the magnet, wa termined at $2\frac{1}{3}$ grains.

f) When the portion of iron had been ſeparated, I a ſmall quantity of vegetable alkali to that part of the tion which yet remained. By this treatment, and quent evaporations, I obtained aluminous cryſtals, i ceſſion, to the end. But, at the ſame time, there ſtill rated ſome *ſiliceous earth*, amounting to 13 grains, heated to redneſs.

g) The whole of the alum (ſulphat of alumine) ob ed, was re-diſſolved in water, and the argillaceous ſeparated by vegetable alkali. This argil, depurated gnited, gave 46 grains in weight.

Therefore, the above 200 grains of *cimolite* produced

Silex	63
Alumine	23
Oxyd of iron . . .	1,25
Water	12
	99,25

With regard to theſe conſtituent parts, and their proportions to each other, the *cimolite* might properly be placed in the mineralogical ſyſtem along with the common ſpecies of clay: but its diſtinguiſhing character, on which, alſo, its other phyſical properties depend, undoubtedly conſiſts in the minutely divided ſtate of the ſiliceous ingredient, as well as the moſt intimate mixture of this laſt with the argillaceous part.

XXI.

CHEMICAL EXAMINATION

OF THE

MAGNESIAN-SPAR (Bitterſpath.)

(Cryſtallized Muricalcite, *Compound Spar*, of Kirwan.)

A*.

MONG the Tyroleſe foſſils, and thoſe of Salzburg, ſo markable by their variety, there occur certain rhombic yſtals, which are moſt frequently found ſingly inter- erſed in a ſlaty chlorite (*Schneideſtein*), mixed with ſilver- ey magneſian lamellas. Thoſe cryſtals have been called *omboidal ſpar* on account of their figure, or *magneſian- r* (*Bitter-ſpath*) on account of this ſuppoſed conſtituent

r-colours. Their hardneſs is a medium between
calcareous-ſpar and that of fel-ſpar; as the firſt
ſcratched by them, but they themſelves may be
d by the ſecond*.

r ſpecific gravity I have found to be 2,480.

n entire piece, weighing 100 grains, was ignited in
ed crucible for two hours; yet, notwithſtanding its
exture, it remained entire, without flying in pieces.
rendered aſh-grey, and wholly opake, though pre-
ſome luſtre. At the ſame time its weight was leſ-
5 grains†.

he action of mineral acids upon magneſian-ſpar,
grofs fragments, is not perceptible; but if pulve-
hey attack and diſſolve it gradually, attended with a
ed gentle effervefcence. With the ſulphuric acid,
is generated, and the ſupernatant ſolution is of a
diſh colour. Nitric acid produces a colourleſs ſolu-
d the muriatic acid a yellow one.

when pieces of calcined magneſian-ſpar are em-
the ſolution goes on rapidly. And in that caſe the
cid leaves a metallic reſidue behind, which ſeparates
wn-red colour.

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re circumſtantial deſcriptions of the external characters of
l have been given by *Karſten* in Beob. u. Entd. a. d. Na-
ol. v. page 56.—*Born* Catal. d. l. Collect. d. Foſſils, vol. i.
5, with the name, *Chaux magneſiée*;—and *Fichtel.* Minerl.
e, page 189.

the habitudes of *magneſian ſpar* in a porcelain-heat, ſee
f the firſt Eſſay.

c) *Three hundred* grains of finely powdered magneſian-ſpar, mixed with an equal quantity of pot-aſh, were ignited for two hours in a crucible. The maſs returned black out of the fire, except that its middle part was rendered of a dark aſh-grey. When triturated, and covered with water, it became light-green. Muriatic acid affuſed upon it, in ſufficient quantity, diſſolved the whole, forming a clear golden-yellow tincture.

d) This ſolution was decompoſed by means of carbonated pot-aſh, and with the aſſiſtance of heat. Sulphuric acid was poured upon the precipitate, previouſly diluted with water, in ſuch a quantity that the acid was predominant. Abundance of ſelenite (*ſulphat of lime*) was thus produced; which ſeparated from the remaining fluid.

e) I next evaporated the ſolution, that remained after the ſeparation of the ſelenite, and which contained ſulphat of magneſia, and a ſmall portion of ſulphated oxyd of iron; carrying on the operation, until the ſaline maſs appeared in a dry ſtate. This laſt I ſubjected to a red-heat for two hours, re-diſſolving it afterwards in hot water. Upon the filter there remained a ſubtle red-brown oxyd of iron, weighing nine grains, and wholly obeying the magnet.

f) The ſolution, now freed from the iron, afforded, by cryſtallization, a pure ſulphat of magneſia; which, when properly decompoſed by pot-aſh, and with the aſſiſtance of heat, yielded 133 grains of *carbonated magneſia.*

g) The ſulphat of lime (*d*), decompoſed by diſſolved carbonat of pot-aſh, furniſhed 160 grains of crude calcareous earth. To examine whether this laſt ſtill contained any magneſia, I diſſolved it again in nitric acid, mixed the ſolution with cauſtic ammoniac, and filtered the precipitate then formed. This immediately diſſolved in ſulphuric acid, which was added, and being precipitated by carbonated potaſh, it ſtill yielded three grains of magneſian earth; which ſubtracted, leaves, therefore, 157 grains for the quantity of crude calcareous earth, or *carbonat of lime*.

Conſequently, I obtained from the above 300 grains of the *Tyroleſe magneſian-ſpar*:

Carbonat of lime	*g*)		157 grs.
Magneſia	*f*) *g*)	133 3	136
Oxyd of iron, containing ſome manganeſe	*e*)		9
			302 grs.

As no loſs of weight, but rather an exceſs, appears in the ſum of the conſtituent parts, given ſeparately, we may conclude, that thoſe ingredients might, perhaps, have been capable of undergoing a ſtill greater degree of deſiccation.

Therefore *a hundred* parts of *magneſian-ſpar* conſiſt of:

Carbonat of lime	52
Magneſia	45
Oxyd of iron, impregnated with manganeſe	3
	100

B.

Although it is only a few years ſince this foſſil was brought to Vienna by ſome Tyroleſe dealers in minerals of their country, and from thence brought into farther notice; yet it ſeems that Woulfe has already been acquainted ier period. For the foſſil, which he ex- ibed in the *Philoſoph. Tranſ.* for 1779 ompound *ſpar*, agrees with the Tyroleſe.

oved, that the magneſian-ſpar is found not rders of the Tyroleſe and Salzburg moun- wiſe in other places, by the following exa- ſpar of that kind, coming from *Taberg*, in province of Sweden.

in the foſſil, in which I have found it of a colour, with a ſtrong luſtre, nearly reſembling mother of pearl, in ſemi-pellucid and rhom- nents. With regard to its fracture, it can iſtinguiſhed from that variety of the Tyroleſe ſpar, which furniſhed the ſubject of the forego- s. The only difference conſiſts in its external is, it does not occur in ſingle interſperſed cryſ- the laſt, but in maſſes; and it is accompanied by a mpact, indurated clay, and a groſs-foliated, deep -green *talc* (magneſian earth.)

ſmall piece of it, ignited *per ſe* upon charcoal, own without ſplitting. It diſſolves, by fuſion, in ſphat, and forms a clear, colourleſs bead. *glaſs of borax.* When tering paper changed to a brown, and, heated to redneſs, yielded 4½ grains of *oxyd of iron.*

c) The ſolution, now rendered colourleſs, was evaporated to a ſmaller compaſs, mixed with one third part of alkohol, and combined with as much ſulphuric acid as was neceſſary to precipitate the ſiliceous earth from the ſelenite or gypſum (*ſulphat of lime*), which was then ſeparated, and waſhed with a mixture of alkohol and water.

d) When the whole of the liquor had been again reduced by evaporation, I precipitated its magneſian earth, by means of carbonated pot-aſh, aſſiſted by a boiling heat. It did not prove to be as looſe as it ought to have been, and thus it ſhewed, that it was not yet pure. Hence, on the affuſion of ſulphuric acid upon this precipitate, more ſelenite was depoſited, which I added to the firſt. The ſolution, thus freed from it, then afforded pure ſulphat of magneſia (*Epſom-ſalt*), which, re-diſſolved and decompoſed in a boiling heat, by alkaline carbonat, afforded 50 grains of *carbonated magneſia.*

e) The ſelenite alſo was decompoſed, by boiling with water and carbonated pot-aſh. Thus I procured from it 146 grains of mild, or *carbonated calcareous earth.*

This *Swediſh* magneſian-ſpar, therefore, contains much leſs magneſia than the *Tyroleſe*; and the proportion of its conſtituent parts in one *hundred* is the following:

Carbonat of lime	73
Magneſia	25
Oxyd of iron, containing a little mangañeſe . . .	2,25
	100,25

XXII.

XXII.

EXAMINATION

OF THE SUPPOSED

MURIACITE.

THE review of our preſent knowledge of mineral bodi
would undoubtedly be much more extenſive, and at tl
ſame time require much fewer corrections, if every new
diſcovered foſſil were immediately put to the chemical teſ
and not received into the ſyſtematical arrangement, till
had been ſtamped with the authentic ſeal of truth.

The *muriacite* does not ſeem to be as yet ſo general
known, that I may not hope to be able to prevent its fa
ther introduction to the public in an erroneous ſhape, l
means of the examination which I am going to deſcribe.

*Fichtel** gives the following account of it.

Abbé Poda *has lately diſcovered a new ſpecies of calcareo*
earth, which, by reaſon of its conſtituent parts, he calls mu
ated lime, or muriacite, *according to the new method of* ɪ
minating foſſils; becauſe that mineral is compoſed of calca
ous earth, muriatic acid, and water. The miners in the ſa
pits at Hall, *in* Tyrol, *call it* ſcaly gypſum (*ſchuppig*
gyps-ſtein.) *But, beſides this difference in its conſtitu*
parts, it is alſo farther diſtinguiſhed from the compact g
ſum: 1ſt, *by its greater hardneſs;* 2dly, *by the quadrilater*

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* See his *Mineralogiſche Aufſaetze.* Vienna, 1794, page 228.

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rectangular ſcales or laminas, of which it is entirely compoſed; and 3dly, *by its much more difficult ſolution in water, of which, at a mean temperature, it requires* 4300 *parts. We expect to receive from the Abbe himſelf the circumſtantial deſcription of this new ſpecies of calcareous earth.*

This foſſil the more deſerved a chemical examination, as hereby we might be enabled to underſtand by what means Nature could produce a combination of the earthy ſaline kind, which in the dry as well as in the cryſtallized ſtate is ſo much diſpoſed to deliqueſcence; but which, as here is ſuppoſed, exiſts in a dry and compact ſtate, and at the ſame time requires ſuch an exceſſive quantity of water to be diſſolved.

That ſpecimen, which has been ſent me from *Vienna*, as *genuine muriacite* of *Hall*, in *Tyrol*, is an aggregate of rectangular, four-ſided plates, of a light-grey, black-grey, and in part reddiſh colour, with bright ſpecular ſurfaces; and hence not ill reſembing groſs-foliated hornblende. By the taſte, and partly even by bare inſpection, it betrays an admixture of ſome portion of rock-ſalt. Trituration reduces it to a white-grey powder.

a) Upon *five hundred* grains of it alkohol was poured; which, after 24 hours, I again ſeparated by filtering. The ardent ſpirit continued colourleſs; and when evaporated, it left pure common ſalt, or muriat of ſoda, behind, in the ſtate of dry cryſtals.

b) This being done, water was affuſed upon the powder, until all the ſaline parts were lixiviated. This aqueous ſolution, which was likewiſe colourleſs, being evaporated to dryneſs, left alſo *common ſalt* behind; but contaminated with *gypſum.*

c) The ſalt obtained in both extractions, and added together, weighed 91 grains. By the affuſion of *one* part of alkohol, mixed with three of water, all the ſalt was diſſolved, and the reſidual *gypſum* amounted to 17 grains. This determines the quantity of the *muriat of ſoda* at 74 grains.

d) I next treated the powder (which had been previouſly extracted both by alkohol and water) with dilute nitric acid; digeſting it gently. Carbonated pot-aſh, added to the nitrated fluid which was again ſeparated, threw down an earth, weighing 26 grains when dried, and conſiſting of *calcareous earth*, impregnated with iron.

e) The reſidue was boiled with water and carbonated pot-aſh. The fluid, filtered off, was then ſaturated with nitric acid. By the addition of muriated barytes, a precipitate was obtained, conſiſting of ſulphat of barytes.

f) Upon the edulcorated reſidue I poured again ſome nitric acid, which produced a great effervefcence. After due digeſtion I ſeparated the fluid by filtration; and, while yet boiling, I combined it with alkali, by which treatment I obtained 76 grains of *carbonated lime.* But as this laſt had exiſted in the foſſil, in a ſtate of combination with the ſulphuric acid, mentioned at (*e*), we muſt only reckon 120 grains of gypſum, or *ſulphat of lime.*

g) What remained, after the extraction with nitric acid, weighed now 265 grains. It was a minute, light-grey, micaceous ſand.

In theſe 500 grains of the foſſil, therefore, have been found:

Muri-

Muriat of ſoda	c)		74
Gypſum	e)	17	137
	f)	120	
Carbonat of lime	d)		26
Sandy reſidue	g)		265
			502 grs.

Hence, the exiſtence of a *native muriat of lime* in the *concrete ſtate*, and alſo the name of *muriacite*, which has been given to it, are incompatible with this reſult.

XXIII.

EXAMINATION
OF THE
NATIVE ALUM
From Miſeno.

THE alum cavern (*grotta di alume*) at the Cape *Miſeno*, near *Naples*, which, as it were, ſerves as a laboratory, where Nature alone, unaſſiſted by art, is conſtantly producing perfect alum, has been mentioned only by few of the Naturaliſts who have viſited that country. Profeſſor *Spallanzani*[*] ſays of this remarkable grotto:—*Before the traveller reaches the promontory* Miſeno, *he meets with its harbour, which, there is no doubt, is likewiſe a crater; as it is ſurrounded on all ſides with eminences. Thoſe elevations conſiſt of tufas, and on one ſide of them, a little above the ſea, there is ſeen an aperture, made by art, which is called* grotta di Miſeno; *and where ſulphat of alumine* (alum) *continually effloreſces. This ſalt is not known by the natives, or at leaſt they pay no attention to it.*

The ſubject of the following analyſis has been a portion of the alum of *Miſeno*, collected on the ſpot itſelf, and given to me by that worthy naturaliſt, *John Hawkins*, Eſq.

All ſaline effloreſcences agree in this, that while they continue in the dry ſtate, they give no ſign of the cryſtalline figure, that is *peculiar* to each particular ſpecies o ſalt. They always appear of a fibrous form. For thi

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[*] Travels in the Two Sicilies, vol. i.

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reaſon alſo, this effloreſced native alum does not preſent its appropriate octahedral form, but is found in ſmall, detached, and roundiſh accumulations, of very thin and ſhort fibres, poſſeſſed of a white colour, and ſilky luſtre, though in part intermingled with minute cryſtalline grains.

a) *One thouſand* grains of this native alum, diſſolved in 10 ounces of boiling water, left 120 grains of a yellowiſh-grey earth on the filtering paper.

b) The clear ſolution, when evaporated for the purpoſe of cryſtallization, gradually, and alone, afforded 470 grains of pure, clear alum, in octahedral cryſtals; although their formation had not been promoted by the addition of pot-aſh. At the ſame time 25 grains of *ſelenite* (gypſum) appeared.

c) Thoſe 470 grains of cryſtallized alum, re-diſſolved in water, were decompoſed, while yet boiling, by carbonated lime. After the ſeparation of the gypſum then generated, I evaporated the remaining fluid, along with the waſhings, to a ſmaller bulk, and freed it from the ſelenite, which ſtill continued to appear. It yielded 27 grains of *ſulphat of pot-aſh.*

d) After this, the remainder of the ſolution of the crude alum, that would no longer ſhoot into ſolid cryſtals, was inſpiſſated, by farther evaporation, to a grey-white, unctuous maſs; being but an imperfect ſulphat of alumine. This ſubſtance might, in the preſent caſe, be conſidered as a true *mineral butter* (*Bergbutter*). By affuſion of water it formed a ſomewhat turbid ſolution; and, by being then treated with a ſmall portion of pot-aſh, it yet afforded 290 grains of concrete *cryſtals of alum.*

e) The above 120 grains of earthy reſidue (*a*) were boiled with mild vegetable alkali and water. The filtered liquor was then ſaturated to exceſs with muriatic acid, and combined with muriated barytes. Upon which ſulphat of barytes fell down.

f) I now drenched in muriatic acid the reſidue, that had been boiled with alkali. This laſt, again ſeparated from it by the filter, was next ſaturated with carbonated pot-aſh. *Eleven* grains of a yellowiſh earth were then precipitated; which, upon cloſer examination, were found to conſiſt of two grains of *oxyd of iron*, and nine grains of *carbonated lime*; which laſt, together with that which had been indicated in combination with ſulphuric acid by the muriated barytes (*e*), amounted to 15 grains of *ſelenite*.

g) The final remainder, which had reſiſted the attack of the muriatic acid, weighed 92 grains, and was a ſandy earth, of a greeniſh-grey colour, meager, and harſh to the feel.

From 1000 lbs. therefore, of this rough, native *alum from Miſeno*, may be produced, barely by ſolution in water, and ſubſequent cryſtallization:

1) *Alum, provided by Nature herſelf with the requiſite quantity of pot-aſh*	470
2) *Alum, whoſe cryſtallization is promoted by adding pot-aſh*	290
	760 lbs.

When, therefore, *Spallanzani* cenſured the natives for not knowing, or for diſregarding this natural product, which is ſo eaſily procured, and which, with ſo little ex-ence, may be made a profitable article of commerce, he was not unſupported by reaſon. This alum of *Miſeno*, it ſhould ſeem, might be of the ſame good quality as that of *Tolfa*; as it can be rendered as free from iron as this laſt, and, as beſides, the proportion of ſulphated pot-aſh would not be greater in it than in the Roman alum.

This portion of ſulphat of pot-aſh, contained in the *alum* from *Miſeno*, occaſions the following queſtion; which indeed it will be ſtill difficult to anſwer at this time.—It is: As this grotto conſiſts merely of volcanic tufa, in which no vegetation takes place, whence does Nature procure the vegetable alkali, requiſite to the generation of the cryſtallizable alum?

Note. Another inſtance of the like daily production of *native alum* occurs at *Solfatara*, where it is procured, and refined after the manner deſcribed by Prof. *Breiſlak.* From the following paſſage of his: *Eſſais Mineralogiques ſur la Solfatare de Pouzzole*, Naples, 1792, page 157, it appears——*That it is upon the ground of the production of theſe ſaline effloreſcences, the abundance and richneſs of which are equally ſurprizing, and, likewiſe, of the exceſſive promptitude of their re-production, that it has been reſolved on to eſtabliſh at Solfatara a manufacture of alum, which of late has been put in activity by Joſeph Brentano Cimaroli.*—In the fuller account of it, given page 231, according to which, the aluminous lixivium, by means of boiling, is brought to ſhoot into cryſtals in no longer time than 24 hours, there is no mention made of any artificial addition of pot-aſh. It is therefore probable, that the alum of *Solfatara*, like the above of *Miſeno*, is already by Nature provided with that portion of pot-aſh, which is neceſſary to the production of perfectly cryſtallized alum.

XXIV.

EXAMINATION

OF THE

NATIVE SALT-PETRE (*Nitrum*),

From Molfetta.

THE *diſcovery of the native ſalt-petre-mine*, or o *Pulo*, producing nitre at *Molfetta*, in *Apulia*, mad Abbé *Fortis*, in the year 1783, could not fail to attrac attention of naturaliſts, in a degree proportionate t importance of the ſubject.

Various philoſophers, who have viſited and examin *Pulo* ſince its diſcovery, have already given circumſt deſcriptions of the natural ſtate of that remarkable p with *Zimmermann* and *Fortis*. In the ſpecimens which I was favoured with, the ſalt-petre inveſted fragments of a yellowiſh-white, compact, lime-ſtone, forming the ſtony matter of the *Pulo*. Theſe fragments, detached from the rock in thin layers, are incruſted with the ſalt, to the thickneſs, for the moſt part, of one ſixth of an inch; when it appears in a finely-grained, cryſtalline form, reſembling white refined, or Canary ſugar. On ſome parts of the lime-ſtone I diſcovered thin incruſtations of a finely-fibrous gypſum, which, in ſome places, ſerved as a baſe for the nitre to reſt on.

a) *One Thouſand* grains of this native ſalt-petre, together with the lime-ſtone and gypſum to which it adhered, were covered with boiling water. The remaining lumps of ſtone having been lixiviated, the clear and colourleſs ſolution, thus obtained, was next prepared for cryſtallizing by gentle evaporation. Each ſhooting of the ſalt was accompanied by tender, needle-ſhaped, ſelenitic cryſtals. No *mother-water* remained: but the whole of the ſolution cryſtallized, to the laſt drop, to a perfect priſmatic nitre. The ſelenite, ſeparated from the ſalt as much as was poſſible, weighed 40 grains; whereas the ſalt gave 446 grains.

b) According to reſearches of Profeſſor *Vairo**, this nitre is ſaid to contain common, or ſea-ſalt, in the proportion of 1 to 6. I therefore expected to obtain, beſides the priſmatic cryſtals of the ſalt-petre, ſome ſea-ſalt alſo, in diſtinct, ſolitary cubes: but no trace of it, viſible to the eye, appeared. For this reaſon, I attempted to diſcover its preſence by another method. With this view, I re-diſſolved, in water, the cryſtals of nitre which I had obtained, and

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* *Voyage à la Nitrière Natur. Zimmerman,* page 35.

droppped diſſolved acetite of barytes into the ſolution. By ſe means I obtained a precipitate, conſiſting of 26 grains ſulphated barytes; which ſhewed, that 18½ grains of nite were ſtill united with the neutral ſalt. When, r this, I tried the nitrous ſolution with muriated ſilver, more than 4½ grains of hornſilver (*muriat of ſilver*) uld precipitate, ſo that the quantity of common ſalt, icated by this laſt, can be eſtimated at only two grains. this, the true quantity of perfectly pure nitre has been uced to 425½ grains.

owever, I think it more probable, that the neutral mu-, which was mixed with the native nitre, was not riated ſoda, but a *muriat of pot-aſh*, or digeſtive ſalt, as s called.

) Upon the ſtony ſubſtances remaining after the lixi-tion of the crude nitre, and which exactly conſtituted half of the firſt weight, viz. 500 grains, I poured mu-ic acid. The pieces of lime-ſtone diſſolved with great rveſcence; leaving a reſidue of 196 grains behind,

Pure priſmatic nitre	*b*)		425½ grains.
Muriated neutral ſalt	*b*)		2
Selenite	*a*)	40	254½
	b)	18½	
	c)	196	
Lime-ſtone	*c*)		304
			986
		Loſs	14
			1000

By the computation of Prof. *Vairo*[*], the total maſs of ſalt-petre in the *Pulo* ſhould amount to between 30 and 40 thouſand centners, at 100 lb. each ; and the ſecond reproduction of it to more than 50 thouſand centners. As, therefore, the alkaline baſe of priſmatic nitre conſtitutes nearly one half of the whole of that compound, it is obvious, that the queſtion which I have intimated at the cloſe of my laſt eſſay, concerning the origin of the vaſt quantity of vegetable alkali, becomes, in the preſent caſe, far more important and intereſting to the naturaliſt. The conjecture, that Nature poſſeſſes means of producing that alkali beyond the limits of the vegetable kingdom, nay, even without any immediate influence of vegetation, acquires, by this ſingular phenomenon, a very high degree of probability.

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[*] Loco Citato. Page 37.

XXV.

CHEMICAL EXAMINATION OF THE *MINERAL SPRINGS, at Carlsbad.*

AMONG the hot mineral ſprings of Germany, that at *Carlsbad*, in *Bohemia*, deſerves the particular attention, not only of the phyſician and the philoſopher, but alſo of every individual that has a due ſenſe of the grand ſcenes in nature.

The baſon of the main-ſpring, that wonderful reſervoir, is, perhaps, the only one of its kind, which Nature herſelf has formed of the conſtituent parts of the ſpring, and, at the ſame time, has covered it by a triple marble-vault, fitted for the collection of the mineral waters produced in the neighbouring ſubterraneous laboratory. The boiling main-ſpring, ruſhing, with vehemence, out of the principal apertures of this water-vault, and filling the atmoſphere with vaporous clouds ;—the inceſſant play of the air-bubbles, forcing their way through the ſmaller rifts and fiſſures, and riſing in the form of pearls through the river Töpel, which flows immediately upon a conſiderable part of that vaulted roof of the ſpring:—all this, at the firſt view, invites the mind to reflection ; at which the ſpectator can hardly avoid falling into the pleaſing illuſion of ſeeing Nature, that uſually likes to operate in a hidden manner, working here cloſe at hand, and, as it were, before his eyes.

I think it needleſs to enter into a topographical and phyſical deſcription of *Carlsbad*; becauſe there already exiſt ſeveral accounts and deſcriptions of it. Among theſe, the *Treatiſe on Carlsbad*, by Dr. *Becher*, may be conſidered as the moſt capital work. I ſhall, therefore, ſuppoſe the reader acquainted with its contents; which, alſo, in general, I refer to in this eſſay.

My principal deſign is, to ſtate our obſervations, and the conſtituent parts of the Carlsbad-water, the decompoſition of which we attempted* at the ſpot itſelf, in July 1789; as well as to compare them with thoſe given by Dr. *Becher*. Beſides this, I alſo intend to ſay ſomething of the manner which Nature, probably, adopts, in elaborating this mineral ſpring, by way of a ſmall addition to the theories that have been already offered on this head.

In our reſearches, we confined our experiments to the three principal ſprings: the main-ſpring, the *new ſpring*, and that in the *caſtle*. Upon the whole, theſe, like the other collateral ſprings that are leſs made uſe of, agree with each other in their conſtituent parts, as well as in the proportion of the more fixed parts, which, in all of them, is much the ſame. But they differ conſiderably from each other in their ſhare of carbonic acid; and this variation is regulated by the temperature, which in one ſpring exceeds that of another; the quantity of carbonic acid being in the inverſe ratio of that of the heat. And for this reaſon, of the abovementioned three ſprings, main-ſpring the hotteſt of all, and whoſe temperature, upon an average, is of 165° of Farenheit's thermometer, contains the leaſt of the acid.

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* For I had the pleaſure of making theſe experiments in company with ***Count Geſsler, Chamberlain and Privy-counſellor to the King of Pruſſia.***

of conducting and collecting the diſengaged gas, through and by means of the hot water of the main-ſpring, inſtead of employing mercury for that purpoſe, cannot have occaſioned any conſiderable difference in the reſult: for water, in general, when of equal temperature with the natural warmth of the Carlsbad main-ſpring, is not capable of abſorbing a notable portion of carbonic acid. And, beſides, ſuch an abſorption of that acid gas could the leſs have taken place in the preſent inſtance, as that water, being naturally impregnated with as much carbonic acid as it can contain, was incapable of taking up an additional quantity of that acid.

If this proportion of carbonic acid, found in the above-mentioned three ſprings at Carlsbad, be compared with that given by Dr. *Becher*, which, calculated to eighteen cubic inches of water, would amount to ſeven cubic inches in the main-ſpring, to $6\frac{3}{5}$ in the new-ſpring, and to 10 in that at the caſtle, there, indeed, occurs a difference; ſince, in our experiments, the carbonic acid extricated from 18 cubic inches of the main-ſpring water meaſured $1\frac{1}{4}$ cubic inch, and from that at the caſtle $\frac{1}{2}$ inch leſs than Dr. Becher's reſults, whereas that obtained from the water of the new ſpring, meaſured $2\frac{1}{5}$ cubic inches more.

But as Dr. *Becher* had the opportunity of employing a quick-ſilver-apparatus, and as, therefore, I have the leſs reaſon to doubt the exactneſs of his experiments, we are, from thence, the more confirmed in the ſuppoſition, that the proportion of the conſtituent parts of mineral waters is not every year, and, perhaps, not every day and hour exactly the ſame, but rather variable. This fact is alſo proved by other phenomena and arguments.

The water of Carlsbad, likewiſe, contains ſome *iron*, the preſence of which can be aſcertained only at the ſpring itſelf;

ſince the quantity which actually exiſts in that fluid is ſo exceedingly ſmall as to eſcape, in a moſt rapid and unexpected manner, the ſenſes as well as the efficacy of re-agents. And, for this reaſon, many perſons have abſolutely doubted the preſence of diſſolved iron in theſe ſprings. But that they contain it, Dr. *Becher* has demonſtrated by the following experiment. He ſuſpended, by a thread, one half of a nut-gall in a glaſs bottle of a narrow neck, and filled the veſſel on the very ſpot with water of the main-ſpring As ſoon as the water, in the action of filling, came in contact with the nut-gall, it acquired a reddiſh colour; but five minutes after, the colour changed to a bright-red, inclining to the violet.

We, likewiſe, made the ſame experiment. Having previouſly ſuſpended a ſlice of a gall, by means of a white ſilk thread, in a glaſs-bottle, of 50 cubic inches capacity, we filled it at the main ſpring. The water inſtantaneouſly turned of a pale red; but after having ſtood at reſt, for one hour, a purple-red, extremely light, woolly, flocculent ſediment ſubſided, which left the ſuperincumbent liquor clear and colourleſs.

Another bottle, in which one grain of pulverized pure Pruſſian alkali had been placed, when likewiſe filled at the ſpring itſelf, ſhewed no change or indication of colour. But ſome minutes after, when we inſtilled ſome drops of nitric acid to ſaturate the predominant ſoda, the blue colour appeared by degrees; ſo that, at length, the water was uniformly tinged blue by it.

The following experiments convinced us, how neceſſary it is to perform theſe trials at the ſpring itſelf. We had ordered a jug, recently filled, at the main-ſpring, and cloſely ſtopped, to be brought to our lodgings; where we immediately, and before the temperature of the water had been ſenſibly lowered, examined it by means of galls, and tincture of galls. But it remained for a while colourleſs; only, by degrees, it inclined a little to a ſeeble, turbid olive-green; and when afterwards a few drops of nitric acid had been added, the colour paſſed into a ſhade of a dilute blueiſh-black.

But when the water from the main-ſpring had cooled more conſiderably, it was no more poſſible to produce, by any means, any change of colour, or indication of iron.

The water of the *new ſpring* afforded the ſame phenomena as that of the main-ſpring; that is to ſay, when the bottle, into which the re-agents had been previouſly introduced, was filled at the ſpring itſelf, the water became coloured, and ſhewed its ferruginous contents. But when conveyed to our apartment, in well cloſed bottles, it was tinged in ſome degree, while its original temperature continued; but as ſoon as the water began to cool, no trace of colour could then be any longer diſcovered.

On the contrary, the water from the *ſpring at the caſtle*, though likewiſe taken at the ſpring itſelf, and there examined, ſuffered no change at all.

It now remained to inveſtigate the other *fixed* conſtituent parts: for this purpoſe, we gradually evaporated, with a gentle heat, *one hundred* cubic inches of water, freſhly taken from each of thoſe three ſprings, down to ſome ounces.

We then ſeparated, by means of filtration, from theſe reſidues, thus reduced by evaporation, the *earthy* parts from the *ſaline*, that were yet held in ſolution by the water, and waſhed and dried them. This earthly portion conſiſted of *carbonated lime*, mixed with *ſiliceous earth*, and a ſlight trace

iron. By digeſting it with muriatic acid, the lime and
e iron diſſolved, and, on the filter, we obtained the ſilex
one, in a looſe, ſlimy ſtate. The muriatic ſolution we
eated, at firſt, with pruſſiat of pot-aſh, and there immedi-
tely appeared blue flocculent particles: however, it was
nly after ſome days that they formed a ſolid precipitate.
Vhen the ſupernatant liquors had again become clear and
olourleſs, and the precipitate had been ſeparated upon the
lter, we precipitated the calcareous earth from each of
em by carbonated ammoniac, edulcorated, and dried it.

We now proceeded to ſeparate the ſalts combined in thoſe
utions. Taught by experience, that heterogeneous ſalts,
iſting in one common menſtruum, can but ſeldom be ſepa-
ed, by cryſtallization, with due accuracy, eſpecially in
all experiments, we adopted another more certain method;
nely, by ſaturating, firſt, the uncombined ſoda by an
d, and decompoſing afterwards the neutral ſalts by proper
ſtances. At the ſame time, by other previous experi-
nts, we had diſcovered and aſcertained the proportions of
ingredients in ſalts of the ſame nature, to be enabled
reby to calculate thoſe reſults.

Theſe laſt mentioned experiments, ſerving as ſtandard
aſures in the preſent purſuit, were principally as follows.

a) Thouſand grains of ſoda, recently cryſtallized and
ighed, after drying on printing-paper, loſt, when com-
tely deſiccated on the ſand-bath, 637 grains of weight.
ouſand parts of ſoda in the ſtate of cryſtallization,
refore, are equal to 363 parts of the ſame alkali, reduced to
owder by a thorough exſiccation effected by means of heat.

) *Hundred* grains of the ſame ſoda, deprived by heat
s water of cryſtallization, required, for their ſaturation,

382 grains of ſulphuric acid, compoſed of a mixture of part of that acid, rectified, and of 1,850 ſpecific gravity, w three parts of diſtilled water.

c) The ſulphat of ſoda, obtained by this ſaturation, completely dried, by evaporating in a ſand heat, weig 132½ grains.

d) One *thouſand* grains of ſulphat of ſoda, recently cryſt lized and dried on printing-paper, when exſiccated to moſt in a ſand-heat, weighed 420 grains.

e) *Hundred* grainsof the above-mentioned glauber-ſ diſſolved in water, and decompoſed by an acetic ſo tion of barytes, gave 168 grains of waſhed and dried ſulp of barytes, or regenerated ponderous ſpar. Thouſand pa of the latter, therefore, contain a portion of *ſulphuric a* equal to 595¾ of ſulphated ſoda, that has been deprived heat of its water of cryſtallization.

f) One *hundred* grains of common ſalt in cryſtals, dri in the air, diſſolved in water, and decompoſed by a nit ſolution of ſilver, yielded 233½ grains of edulcorated a dried muriat of ſilver, or precipitated hornſilver, as it called. Whence the quantity of muriatic acid, contain in 1000 parts of this laſt, is equal to 428¼ parts of pure a dry muriat of ſoda.

Aſſiſted by theſe diſcoveries, we could now, with certaint expect the ſucceſs of our attempt without danger of err by making a proper uſe of them. Thus we firſt inveſt gated the quantity of free or *carbonated ſoda*, by adding every one of thoſe ſolutions as much of an accurate weighed quantity of ſulphuric acid, of the ſpecific gravi mentioned, (*b*) as was neceſſary to a complete ſaturatio

a

and from the portions of the acid employed in theſe proceſſes, we computed the quantity of the alkali contained in each of the ſolutions.

This done, we combined the muriatic ſolutions with diſſolved acetate of barytes, until all precipitation ceaſed. From the weight of the *barytic ſulphat* then generated, we calculated the quantity of ſulphated ſoda: having, before, ſubtracted that portion of it, which had been produced by the ſaturation of the uncombined ſoda, and united with the glauber-ſalt, naturally contained in the ſpring.

At laſt, we decompoſed the common ſalt, left in the ſolutions after the ſeparation of the barytic ſulphat, by means of a nitrated ſolution of ſilver; and we computed the quantity of that muriated ſoda from the hornſilver, obtained by the proceſs.

It reſulted from theſe experiments, that

A) *Hundred* cubic inches of water from the *main-ſpring*, at Carlsbad, contain:

Dry carbonated ſoda	39 grains.
(or, in cryſtalline ſtate, 107½ gr.)	
Dry native ſulphat of ſoda	70½
(or, in cryſtals, 168 gr.)	
Muriat of ſoda	34⅛
Carbonat of lime	12
Silex	2½
Oxyd of iron, about	⅛
Total . .	158¼ gr.

Carbonic acid gas, 32 cubic inches.

9

B)

B) *Hundred* cubic inches of the water, taken from th
w-ſpring, contain:

Dry Carbonat of ſoda . . . . . . (or, cryſtallized, 106 gr.)	38½ grains.
Dry native ſulphated ſoda	66¾
(or, cryſtallized, 159 gr.)	
Muriat of ſoda	32½
Carbonat of lime	12⅜
Siliceous earth	2¼
Oxyd of iron, hardly	⅛
Total . .	152½ grains.

Carbonic acid gas, 50 cubic inches.

C) And laſtly, an *hundred* cubic inches of water from the
ing at the caſtle yielded,

theſe experiments, has been made the ſtandard, is equivalent to 290 grains of diſtilled water, (of the genuine medicinal weight of Nurenberg [*]). The above 100 cubic inches, therefore, with reſpect to their ſolid capacity, are equal to $60\frac{5}{12}$ ounces of water.

On comparing the fixed conſtituent parts, diſcovered by Count *Geſsler* and *myſelf*, with thoſe given by Dr. *Becher*, I ſhall notice merely the water of the main-ſpring. The quantity of it, which he employed, in every inſtance, was ſix pounds medicinal weight. Dr. *Becher* obſerves, that he means the old apothecary's weight and meaſures, formerly uſed there; which is, to that now introduced, as 12 to 14; but I ſuppoſe that the above is the ſame with the uſual medicinal weight, of 12 ounces, or 5760 grains. Therefore, by calculating, according to theſe data, the dry reſidue which we ſhould have obtained from 6 lb. medicinal weight, or from $119\frac{5}{29}$ cubic inches of water from the main-ſpring, would have amounted to $189\frac{27}{143}$ grains; and this very nearly agrees with the 192 grains obtained by Dr. B., the difference of $2\frac{118}{143}$ being very unimportant, eſpecially as he himſelf has alſo obtained three drachms, or 180 grains leſs of this dry reſidue from an equal quantity of the main-ſpring water. With regard to the *proportion* of the fixed parts to one another, Dr. *Becher* thinks that the ſeveral conſtituent ingredients, in thoſe 192 grains, may be divided in the following manner:

Dry ſoda	53 grains.
—— *Sulphat of ſoda* . . .	93
Muriat of ſoda	26
Calcareous earth	$20\frac{1}{2}$

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[*] Or $278\frac{3}{4}$ grains, *Engliſh Troy*, very nearly. Tranſl.

But, according to the reſult of our experiments, the above-mentioned 192 grains of the reſidue of the water from the main-ſpring would afford,

Dried ſoda	47¼ grains.
—— *Sulphat of ſoda.* . . .	85¼
Muriat of ſoda	42
Calcareous earth	14½
Siliceous earth	3

To explain theſe variations, beſides firſt repeating the obſervation before mentioned, that in mineral waters the proportion of the ingredients is not, at all times, invariably the ſame, I believe the following remark may be of ſome aſſiſtance in elucidating the difference.

a) Dr. *Becher* procured the *ſoda*, which he uſed in his preparatory experiment, by diſſolving, in water, the calcined reſidue of the deſiccated mother-water; and, having cryſtallized it, he conſidered the ſalt obtained, at the third ſhooting, as pure mineral alkali, and employed it accordingly. This, however, cannot eaſily be preſumed to have been perfectly pure, but was probably ſtill mixed with ſome common ſalt; which ſuppoſition ſeems to be ſtrengthened by the figure of the cryſtals, deſcribed as minute-grained and needle-ſhaped. On every account it would, indeed, have been not ſuperfluous to have tried, before-hand, by experiments, the purity of the ſoda, and the total abſence of all neutral ſaline admixtures. For, in proportion as the ſoda employed in the comparative experiment was ſtill rendered impure, by any foreign ſalt, in the ſame ratio muſt the calculation, founded upon it, have given an exceſs of ſoda above the true quantity which enters into the water of the ſpring.

b) That the portion of *common ſalt* was found to be much leſs by Dr. *Becher*, than by us, ariſes from the uncertain method which he has employed to ſeparate the ſulphat and muriat of ſoda, by mere cryſtallization; ſince the former, eſpecially in the laſt ſhootings, always attracts to itſelf a portion of the latter, which accompanies it in the lye. Therefore,

c) The proportion of the *neutral ſulphat* of the ſpring, as determined by calculation, muſt, for the ſame reaſon, have appeared greater than it really is.

d) The *ſiliceous* ingredient in the water of Carlsbad has entirely eſcaped the attention of Dr. *Becher*, as it did other authors, who treat of this ſpring. This, however, may be excuſed, becauſe ſilex has been formerly conſidered as a ſubſtance totally inſoluble in water, and, therefore, has never been ſuſpected to be a conſtituent part of mineral ſprings. But it cannot be allowed that this earth is only caſually admixed with the water, and floats in it as a fine ſand; for, that it exiſts in it in an actual ſtate of ſolution, is evident, from the ſwelled, ſlimy, and tranſparent ſtate in which it remains after the ſolution of the calcareous earth.

Nevertheleſs, this quantity of ſiliceous earth, in Carlsbad water, whoſe ſolvent power over this earth is aided by its temperature, great as it may appear, with regard to other mineral ſprings, is, in fact, but inconſiderable, when compared with the ſilex, contained in a much larger portion, in other hot-ſprings; the *Geyſer*, for inſtance, in *Iceland*. But it muſt alſo be obſerved, that the temperature of this laſt ſo far exceeds that of Carlsbad, that, according to *Troil's* teſtimony, even when this immenſe jet of 19 feet in diameter had riſen, as it often does, to the height of 90 feet, its water is ſtill found perfectly boiling hot, when it again comes down to the ground.

I ſhall now give an eſtimate of the quantities of the conſtituent parts of the water of Carlsbad, taken by its viſitors. The mean number of cups which are drank is 14 in the day, as the daily allowance is from 10 to 18; the immoderate quantity of 30 or 40 cups, and upwards, which were formerly taken, being now laid aſide: one of theſe cups, upon an average, holds nearly 10 cubic inches of water; and, therefore, will hold 140 cubic inches, which contain:

Cryſtallized carbonated ſoda . .	150½ grains.
———— *Sulphat of ſoda* . .	228
Muriat of ſoda . . . . , . .	48
Calcareous earth	17⅓
Siliceous earth	3½
Oxyd of iron	¼

Carbonic acid gas, 45 cubic inches.

The time uſually ſpent in the medicinal uſe of this ſpring is from three to five weeks. If, therefore, we aſſume, at a mean rate, 26 days for the whole of that time, and calculate by it the quantity of water drank by each patient, it will be found to amount to 364 cups, holding 3640 cubic inches of the mineral water, which contain,

Cryſtallized cerbonat of ſoda . .	3913 grains.
———— *ſulphat of ſoda* . .	5928
Muriated ſoda	1248
Calcareous earth	450
Siliceous earth	91
Oxyd of iron	6½

Carbonic acid gas, 1170 cubic inches.

It is not my province to ſpeak of the medicinal effects of the mineral ſpring at Carlsbad. On this ſubject various celebrated phyſicians and writers, as *Fred. Hoffmann*, *Tralles*, *Springsfeld*, *Zückert*, and in particular Dr. *Becher*, the reſpectable author of the above-mentioned *Deſcription of Carlsbad*, have given ſufficient information and inſtruction.

On one point, however, I ſhall briefly touch. Many perſons, leſs verſed in chemiſtry, are of opinion, that the native glauber-ſalt of this mineral ſpring is eſſentially different from, and preferable to any other ſulphat of ſoda; upon the ground, that a moderate quantity of the water, for inſtance 14 cups, in which that neutral ſalt, calculated in the cryſtalline ſtate, amounts only to 228 grains, or 12 grains leſs than half an ounce, is found to poſſeſs a greater aperient power than any other artificial glauber-ſalt, though taken in greater proportion. But in this ſtatement, which is confirmed by experience, we ſhould not forget to have due regard to the influence of the ſoda; becauſe the alkaline ſubſtances and earths are converted into neutral or middle ſalts, in the ſtomach and firſt paſſages, whenever, as is moſtly the caſe, any acid there predominates, and they thus acquire the cathartic properties of other purging ſalts. Nay, it is probable that it is owing to this conſtituent part of the Carlsbad water that ſeveral perſons, whoſe humours in the ſtomach and firſt paſſages are, perhaps, more diſpoſed to *alkaleſcence* than *acidity*, often experience, on its internal uſe, effects quite contrary to thoſe which they expected from its opening power. Moreover, the ſiliceous ingredient may be frequently an acceſſory cauſe of the unpleaſant effects on the bowels, which the water produces in thoſe perſons in whom the *periſtaltic motion* is rather languid.

However, theſe, as well as all other medical remarks, I leave to the phyſicians, and will allow to myſelf only ſome reflections concerning the ſubſtances, which Nature employs to impregnate the Carlsbad mineral ſpring with the above-mentioned ingredients, and concerning the manner in which perhaps, it operates in this proceſs. I ſay, *perhaps*, ſo the ſearching mind of man is not endowed with the facult of inſpecting the interior and ſecret receſſes of the laboratory of Nature, without danger of error. All that we a able to do, is to ſuſpect, and to draw probable conjectur from phenomena ſimilar to thoſe, which we have had oppo tunity of perceiving either in the operations of Nature herſel or in our ſmall chemical experiments.

The cauſe which produces the heat in the ſprings a Carlsbad is variouſly ſtated by philoſophers. The opinio of a great fire, ſuppoſed to exiſt in the centre of the globe to which, formerly, all the great phenomena in the ſubterraneous laboratory of Nature, and hence alſo the generatio of hot mineral ſprings, have been aſcribed, has, at preſent ſcarcely any ſupporter. Others would account for tha cauſe by the volcanos, which are ſaid to have once exiſte in that country, and, though burned out on the ſurface, ar not yet perfectly extinguiſhed beneath. But this, likewiſe is an ill-founded hypotheſis; as neither a true crater, no what might have once been the fire-gulph of a volcano, no any undoubted lavas and other matters ejected from it, ca be found there. In fact, the earthy ſcoriæ, met with in th vicinity of Carlsbad are not of a true volcanic origin; an as little may the baſalts, which are there met with, be con ſidered as an additional proof of the volcanic nature of th country.

Thoſe naturaliſts ſeem to come nearer to truth, who trac the efficient cauſe of heat in theſe ſprings from ignited ſu phur-pyrites. With this opinion, likewiſe, the celebrate author of the Treatiſe on Carlsbad Water coincides, whe explaining the temperature of its ſprings. And, indeed, cannot be denied, that pyrites act their part in this caſ

Fc

For the ſtratum of pyrites, which is only a few miles diſtant from Carlsbad, and from which the ſulphur and vitriol-works at *Altsattel* are plentifully provided with that crude material; beſides, the ſiliceous ingredient diſſeminated in the ſtony mixture of that ſtratum, under which, according to all indications, that ſubterraneous laboratory lies where Nature prepares the mineral water; and, laſtly, thoſe conſtituent parts of theſe mineral ſprings, the origin of which we cannot explain from other ſubſtances beſides from ſulphur-pyrites: all theſe circumſtances coincide to give weight to that opinion.

Yet, on a maturer conſideration, it will ſoon be evident, that the diſſolved pyrites could not alone afford that quantity of caloric, which has heated the ſprings at Carlsbad, for ſeveral centuries paſt to this day, with unabated force; but, on the contrary, that, to the production and preſervation of natural hot ſprings in general, another combuſtible matter is required, from which the ſubterraneous fire receives its food. And thus it will be obvious, that this fuel can be nothing elſe but mineral coal, that remainder of vegetable fragments of the ancient world, locked up in the boſom of the earth, which provident Nature has wiſely reſerved.

When a ſubterraneous ſtore of mineral coal, ſuch as occur in various places in ſtrata, of an enormous thickneſs, has been once ſet on fire, by ignited pyrites or other cauſes (as may eaſily happen, eſpecially where the ſtratum comes out near to the day) the inflammation will then ſpread throughout the whole remaining maſs, with a quicker or ſlower progreſs. A ſpontaneous extinction and complete refrigeration can certainly not be very ſoon expected in that caſe; for the larger the bulk of a burning body is, the longer will the heat, excited by it, continue. If, beſides, it is conſidered, that this immenſe maſs may poſſibly be incloſed by walls of

cks, impenetrable, and little capable of conducting heat,
the ſame time that the air finds acceſs to it in but a very
all degree; it is then eaſy to conceive, that ages muſt
ſs before the caloric diſengaged from ſuch an immenſe
aſs can be fixed again, and brought to a ſtate of equili-
ium with the whole.

But that a mine of mineral coal had once been burning at
arlsbad is a fact, unqueſtionably proved by the earthy
oriæ that have been erroneouſly taken for genuine volcanic
vas, by the porcelain-jaſpers, and by the other ſpecies
ſtones and earths, more or leſs changed by fire, cover-
g the fields at *Hohdorf*, *Leſſa*, and other places, in copious
antity, many of which perfectly reſemble the pſeudo-
lcanic products of various countries; ſuch, for inſtance,
the ſtratum of mineral coal even now burning at *Dutt-*
iler, near *Saarbrück*.

Carlsbad, which is ſituated in a narrow, longiſh valley,
on all ſides ſurrounded by mountains of the middle ſize;

common opinion, which is alſo ſupported by various local circumſtances, that underneath this mountainous range, the laboratory lies, where Nature produces that beneficial ſpring. For, not only does the vaulted roof of the baſon, or reſervoir of the main-ſpring, (the breadth of which extends from the Guildhall, along and under the market-place, as well as under the bed of the river *Töpel*, to the church) proceed from the foot of that low rock, but alſo all the other ſprings iſſue from it; beſides, that the warm mineral water oozes out from ſeveral other of its fiſſures and veins. But, if this ſtony matter is granted to be of ſecondary formation, and not a primitive rock, the poſſibility of a mighty ſtratum of mineral coal, lying under it, can no longer be queſtioned.

Now, concerning the generation and origin of thoſe conſtituent parts, with which this hot water is impregnated, and thereby ennobled to the rank of a medicinal ſpring; theſe depend on the *very ſame laws of nature*, which chemiſtry has learnt by experiments to be ſuch, and by which it is guided in imitating the operations of Nature in the ſmall way. Yet, our knowledge, it muſt be confeſſed, is not always ſufficient to comprehend, accurately and diſtinctly, the method which Nature employs in every particular inſtance. Nature, in her great operations, always proceeds in a ſimple way; whereas, we being but humble imitators of that great miſtreſs of chemiſtry, cannot help reſorting to artificial, and thence imperfect proceſſes, whenever we attempt to obtain the ſame products from the ſame principles.

Firſt, as to the origin of the *carbonic acid* in the water of Carlsbad, the opinion of the author of the *Neue Bemerkungen über das Carlsbad*, who deduces the gas of that ſpring from the ſulphur-pyrites themſelves, cannot ſubſiſt;

for,

for, what is extricated from mouldering pyrites is not the carbonic, but the *ſulphureous acid*, combined, according to circumſtances, with *hydrogen gas*. On the contrary, it admits of no doubt, but that *limeſtone* is the principle, which in all caſes, and hence in this alſo, affords the carbonic acid. From the fact already related, that the rock ſeated upon the laboratory of this ſpring is of a younger date, and later formation; it is certain that limeſtone may be preſent at ſome depth; whether it conſiſt of primitive calcareous rock, or of ſtratified calcareous ſtones; and that it actually and neceſſarily there exiſts, is manifeſt from this very daily generation of ſo great a quantity of carbonic acid. But, whether the developement of this elaſtic acid from the limeſtone is effected merely by the heat, or by means of the ſulphuric acid, diſengaged from the diſſolved pyrites, is a queſtion which cannot be *poſitively* anſwered. It is, however, probable, that it is expelled by heat alone.

With regard to the generation of the *neutral ſulphat*, or the *glauber-ſalt*, it undoubtedly cannot take place, but when veins of common ſalt come into contact with diſſolved ſulphur pyrites. Part of the muriated ſoda is then decompoſed by the ſulphuric acid, and unites with it to a new neutral ſalt, *viz.* the native glauber-ſalt, or ſulphat of ſoda.

And, as the exiſtence of carbonic acid in the Carlsbad water neceſſarily preſuppoſes the preſence of a calcareous ſtratum; the enquiry into the origin of the calcareous earth, diſſolved in this mineral ſpring, is anſwered of itſelf. It is by the ſpontaneous ſeparation of that earth from the water, that the above-mentioned wonderful ſtone-vault, of the great reſervoir, together with the remaining vaſt quantity of variouſly formed ſtalactites and tufas, have been produced, and are daily augmented. Therefore, it is not neceſſary to ſearch in vain, with Dr. *Becker*, and againſt all

rules,

he origin of the calcareous earth in the mixture
es ; nor to lay any ſtreſs on the ſmall quantity,
t be an accidental ingredient in the muriated
oyed by Nature in the production of the mine-
at Carlsbad.

annot judge with equal certainty of the method
Nature, in generating the uncombined ſoda
the Carlsbad water ; ſince, of all the methods,
re able to employ for the ſame purpoſe, there
ſuch a kind that we could fairly ſuppoſe to be
he operations of Nature, who always accom-
nds by the ſhorteſt ways. It is probable that
nued influence of the ſubterraneous heat, and
urs, are alone ſufficient to volatilize part of the
d of the muriated ſoda, leaving behind the al-
iple that had been united with it.

predominant portion of free ſoda alſo depends in
culiar taſte of Carlsbad water, which, when
, may be compared to a weak meat-broth.

yrites, *mineral coal*, *limeſtone*, and *brine-ſprings*
ſoda, are, therefore, the raw materials made
ature in elaborating thoſe hot mineral ſprings.
ous the ſtore of them muſt be, may be conceiv-
ing upon the quantity of water, and its ingre-
ch is afforded by the *main-ſpring* alone, in the
ne year. By the computations of *Dr. Becher*,
05 *eimers* in an hour, from the five orifices of
which makes, for one day, 16,920 ; and hence,
, 6,175,800 *eimers*. And, if the *eimer* be taken
to *one half cubic foot*, that quantity amounts to
ubic feet of water. Theſe contain:

	Pounds avardupoiſe.
Cryſtallizable ſoda	746,884
———*ſulphat of ſoda* . .	1,132,923
Muriat of ſoda	238,209
Calcareous earth	86,020
Siliceous earth	17,369
Oxyd of iron	1,240

Carbonic acid gas 992,539 cubic feet.

nd, ſince the quantity of water yielded by the *new-* ıg, by that *at the mill*, and by the *other ſtreamlets* iſſuing ı the clefts of the rifty rock, taken together, may be nated as equal to that afforded ſolely by the main- ıg; our aſtoniſhment is juſtly excited, on conſidering immenſe quantity of products which have been ſent ı by thoſe ſprings at Carlsbad, within a term of 420 s; that is, from 1370, which is the period aſſumed in ory for their diſcovery, to 1790.

ated with carbonic acid, that penetrates through the
of the baſon, and covers the fluid in a ſtratum from
ix inches thick. Its taſte is ſo exceedingly ſour,
ubt has ariſen, whether that acidity depends merely
roportion of the carbonic acid. But experiments
wn it to contain no other extraneous acid; and the
of carbonic acid gas was found to be equal in
to that of the water itſelf, where 18 cubic inches
have yielded 18 cubic inches of the gas. This *aci-*
ring hardly contains any fixed conſtituent ingredi-
r, when a conſiderable quantity of it has been eva-
by the aſſiſtance of heat, a reſidue was indeed left,
oved to be a neutral muriat, but ſo ſmall, as almoſt
obſervation.

valuable, but, at Carlsbad, little eſteemed ſpring,
, deſerves to be protected againſt the caſual impu-
which it is now liable to be defiled, by a more
incloſure and careful covering; as well as to be
nmonly applied, both for *medicinal* and *economical*
.

XXVI.

P

Cryſtallizable ſoda . . . .
———— *ſulphat of ſoda*
Muriat of ſoda . . . .
Calcareous earth . . .
Siliceous earth . . .
Oxyd of iron . . .

Carbonic acid gas 992

INATION

KÖNIGSBORN,

Products *.

—

And, ſince the quan
ſpring, by that *at the*
from the clefts of th … others, chiefly belong to thoſe
eſtimated as equal … of which the induſtry of
ſpring; our aſtoniſh … but little occupied. This want
the immenſe qu … knowledge of the conſtituent
forth by thoſe ſp … cannot fail to have occaſioned a
years; that i … in the ſalt-works; and, the
hiſtory for th … correcting them, is in general
… experienced for many years.

Yet, … have been avoided in the calcula-
contents … for inſtance, inſtead of employing
ral ſprings … deceitful, empirical ſcale, which hi-
ſulphate … alone reſorted to, and truſted, in aſ-
porati … of ſalt contained in any brine,
it … able to proceed upon the ground
try, … knowledge, founded on chemical ana-
em … portion, as well as of the other
… which are the habitual concomitants of
… For this reaſon, I believe, that by publiſh-
… into the ſaline ſprings, and their va-
… *ſalt-works* at *Königsborn*, near *Unna*,

… *Abhandlungen der Königlichen Aca-*
… Berlin, 1794.

in

ications, perhaps, not an unim-
mical knowledge of ſaline

—

at *Königsborn* conſiſts of a
parated in ſtrata, and diſin-
ſeem to reſt immediately upon
ad rock *. They extend in a di-
to weſt, from *Paderborn*, between the
Emſche, as far as the dukedom of *Cleves*;
cline, from ſouthweſt to northweſt, into the
of *Münſter*, where they are covered by ſtrata of
and loam. The ſalt-ſprings at *Salzkotten*, *Weſtrinkotte*, *Werle*, *Saſſendorf*, and *Unna*, which have been uſed for many centuries paſt, and ſeveral indications of a weak brine, near *Bochum*, in the *Dortmundt* territory, &c. are likewiſe ſituated on the ſame mountains.

The preſent ſalt-work at *Königsborn* lies about one mile (Engliſh) diſtant from *Unna*, to the north, in a plain; accompanied on both ſides by gentle elevations. Wherever the ground is perforated or dug, at and below Königsborn, towards the north, there are always ſalt-ſprings found; but above Königsborn, ſouthwards, ſprings of ſweet water exiſt, which come forth to the day, and even will riſe in pipes to 10 or 12 feet. On this account, the brine has been procured, for many years paſt, by means of ſuch perforations, of which there have been more than twenty, of a depth from 75 to 280 feet. The brine obtained from theſe, at a depth from 50 to 80 feet, always contains from 1¼ to two ounces of ſalt in the pound; that from 80 to 120 feet, contains 2¼ ounces; but that from 120 to 200 feet, affords 3¾, and even 3½ ounces; and it is pumped up to the height of 12 feet above the ſurface, by means of the above-mentioned wooden pipes, in a quantity amounting to from three to four cubic feet every minute. Experience has ſhewn, that this ſaline ſpring has decreaſed in dry weather, in quantity of water, and richneſs of ſalt; but has increaſed, in both reſpects, in wet weather, or when in the midſt of ſummer it has rained only a few days, after a great drought. However, after the lapſe of four or ſix years, the brine has been ſo much impoveriſhed, at every well, as to yield only 1½ ounce of ſalt; although neither the quantity flowing out had increaſed, nor had the brine been otherwiſe altered. As often, therefore, as this happened, a new perforation has been made, by which means a brine, 3 or 3¼ ounces, rich in ſalt, was again obtained for ſome time. From this account it would ſeem, that there exiſt three diſtinct ſalt-ſprings lying upon each other; that the deepeſt are the richeſt; which, therefore, by their riſing, force away the upper and lighter ones; and, that theſe laſt muſt be in conjunction with ſome ſtream, the ſweet water of which waſhes a maſs of ſalt, and thereby becomes impregnated with part of it. Hence may be explained the rapid increaſe of the quantity of the fluid, and of its proportion of ſalt, after rainy weather. In conſequence of this conjecture, ſome years ago, ſhafts were ſunk between the ſeveral borings; the lighter ſprings were ſtopped up, and the richeſt were brought out to the day. However, the event was, that by means of this perforation, at the 111th foot in depth, a copious ſpring was come at, but only one ounce in richneſs; which poured into the well, that was already 60 feet deep, in ſuch quantities, that at every minute 25 cubic feet were to be overcome. On the very day that this ſpring had been pierced, the ſaline contents in the ſeveral brines augmented in all the wells, from 1¼ ounce to 1½, 2, and even 2¼ ounces. This weak brine, therefore, ſeems to impoveriſh the richer ones, by penetrating through the fiſſures of the marly rock to the perforated cavities; and either keeping off the deeper ſprings of 3 ounces richneſs in ſalt, or mixing with, and thus lowering them down to 1 and 1¼ ounce.

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* By the *dead rock* is underſtood the ſtone, or ſubſtance, which lies between the primary and ſecondary ſtrata, and participates of the nature of both. The Germans call it *todt-liegendes*; *Kirwan* calls it *ſemiprotolite*, and likewiſe *deadlier*. See his *Geological Eſſays*. Lond. 1799. page 225; and his *Elements of Mineralogy*. Lond. 1794. vol. i. page 363.—Tranſl.

To ſhew what quantity of ſalt may be procured from theſe ſprings, I ſhall ſelect the period of three years; namely, from the 1ſt of June, 1788, to the laſt of May, 1791. During that time were procured:

35,521,534 pounds.

This gives for one year:

11,850,511⅓ pounds.

By taking into the calculation the loſs occaſioned by the *boiling*, which has been aſcertained by actual experiment, as well as the loſs ariſing from the *graduation* *; which, by eſtimation, is reckoned at 37 *per cent*, there will be required of the brine, to obtain the above produce in each year:

336,069,731 pounds; or,
4,972,748⅓ cubic feet.

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* In other words: from evaporating the brine by means of air, previous to their boilings, in particular buildings, called *graduating-houſes*. Conſult *Gren's Principles of Modern Chemiſtry*. Lond. 1800. vol. i. page 294.—Tranſl.

In ſpeaking of the chemical examination of thoſe ſprings, to avoid unneceſſary repetitions, I ſhall only in general explain the method in which I have proceeded in this inquiry; and, with reſpect to each particular ſpring, &c. I ſhall merely ſtate the reſult of my experiments:

1.) In order to determine the ſpecific gravity of each brine, I meaſured 50 cubic inches (each equal to 290 grains of diſtilled water); weighed, and compared them with the weight of an equal quantity of diſtilled water.

2.) Theſe 50 cubic inches of brine were then evaporated, in a ſand-heat, to a dry reſidue, and the weight of it noted.

3.) Theſe reſidues were then covered in cylindrical glaſs-veſſels, with alkohol, and extracted by means of it during 24 hours, at a moderate temperature, and with repeated ſtirring.

4.) After the alkohol had been again ſeparated by filtration, it was evaporated to dryneſs. Upon the reſidue left by it, freſh ardent ſpirit was affuſed, in ſuch a quantity as was neceſſary to ſeparate the ſmall portion of common ſalt, which had united with the ſpirituous ſolution, at the firſt extraction. After this, the laſt alkohol was likewiſe evaporated, and the reſidue weighed.

5.) That portion which had been extracted by alkohol conſiſted of *muriat of lime*, mixed with a very trifling portion of *muriated magneſia*; the proportion of which laſt was determined in the following manner:—The reſidue, obtained by the evaporation of the alkohol, was diſſolved in water, the ſolution heated, and the earth precipitated by ſoda. This earth, when waſhed, was combined with ſulphuric acid, added in exceſs. After the mixture had ſtood for a while in a warm place, and the predominant acid had been again abſorbed by carbonat of lime, which was added for this purpoſe, the liquor was freed from the ſelenite or gypſum then generated, and evaporated by a gentle heat. When the ſelenite, which ſtill appeared, was again ſeparated, and the liquor ſufficiently reduced, the ſolution was expoſed to ſpontaneous exhalation in the open air, and thus made to cryſtallize. The ſulphat of magneſia, produced by this proceſs, was rediſſolved in water, and decompoſed by ſoda; upon which the magneſia, which ſeparated, was ſaturated with muriatic acid, evaporated to dryneſs; and the weight of this muriated magneſia ſubtracted from the muriated lime.

6.) The deſiccated muriat of ſoda, remaining after the ſeparation of thoſe deliqueſcent ſalts, by means of alkohol, was next diſſolved in water, and filtered.

7.) The remainder on the filter conſiſted of *ſulphat* and *carbonat of lime*; and in ſome, brines of *oxyd of iron.*—When weighed, it was treated with muriatic acid, and the ſelenite ſeparated upon the filter. The filtered ſolution, when it appeared to contain a ſeparable portion of iron, was combined with cauſtic ammoniac; and the oxyd of iron, which fell down as a brown flocculent precipitate, when collected by the filter and ignited, was weighed, and its weight reduced to that of carbonated iron.

8.) I combined the muriatic ſolution of No. 6 with carbonat of ſoda, aſſiſted by heat, when a precipitate enſued, conſiſting of carbonated lime. The ſoda, employed for its precipitation, having thus been again neutralized by the muriatic acid, I treated this muriatic ſolution with muriated barytes. From the ſulphat of barytes, obtained by this management, it was obvious that the calcareous earth precipitated,

9

precipitated, by the carbonated ſoda, from the diſſol muriat of ſoda, had been combined with ſulphuric acid the character of *ſelenite*. In like manner, it followed fi the proportion, which the quantity of ſulphuric acid bor the calcareous earth, obtained in a ſtate of combinat with it, that the muriatic ſolution contained ſelenite o and no glauber-ſalt, nor any other alkaline or ear ſulphat. The total abſence of theſe laſt was alſo confirm by this; that the dry ſalt gradually diſſolved in a mixt of two parts of alkohol with one of water, which I affu upon it; and, that at laſt nothing but ſelenite remained.

The experiments, performed in the manner here plained, gave the following reſults:

A.

Brine of the Varsthauſer-ſpring.

Its ſpecific gravity was 1039 (diſtilled water bei 1000).

Fifty cubic inches, evaporated to dryneſs, afforded a gr white reſidue, weighing 882 grains.

This reſidue conſiſted of:

Muriat of lime	46 grains.
——— *magneſia* . . .	1
Carbonat of lime	12
Selenite, or ſulphat of lime .	25
Muriat of ſoda . . .	798
	882

B.

Brine of the Glückauf-ſpring.

Its ſpecific gravity was found to be 1029.

Fifty cubic inches left a pale-red reſidue of 585 grains, containing:

Muriat of lime	32 grains.
——— *of magneſia* . . .	1
Carbonat of lime	11
Carbonated oxyd of iron .	1
Selenite	18
Muriat of ſoda, or *common ſalt*	522
	585

C.

Brine of the Frederic-anton-ſpring.

Its ſpecific gravity was 1025.

Fifty cubic inches left, by evaporation, 540 grains, of a light-reddiſh reſidue, conſiſting of:

Muriated lime, including a ſcarcely obſervable trace of *muriated magneſia*	20 grains.
Carbonated lime, or crude calcareous earth	11½
——— *oxyd of iron*	½
Selenite, or gypſum	14
Muriated ſoda	494
	540

D.

Brine of the Goldener Sonnen-ſpring.

The ſpecific gravity was 1024.

The dry reſidue, yielded by 50 cubic inches, light-grey-white colour, and weighed 521 grains, reſolved into:

Muriat of lime	30	grains.
——— *of magneſia* . . .	½	
Carbonat of lime	11	
Selenite	15	
Muriat of ſoda . . .	464½	
	521	

E.

Brine of the Ludwigs-ſprings.

Its ſpecific gravity 1023.

The light-reddiſh reſidue, from 50 cubic inches evaporated brine, weighed 508 grains, and contained

Muriat of lime	20	grains.
Carbonated lime	10	
———— *oxyd of iron* . .	½	
Selenite	13	
Common ſalt, or muriated ſoda	464½	
	508	

e brine, which is brought up from the various ſalt-ings, is conducted into one common reſervoir, from ich it is pumped to the top of the *graduating-houſes*, here it is three times *graduated.*

F.

Brine of the firſt graduation.

Its ſpecific gravity roſe to 1060. The reſidue from the evaporation of 50 cubic inches weighed 1285 grains; nd conſiſted of:

Muriated lime	65 grains.
——— *magneſia*	1½
Carbonated lime, containing ſome iron	4½
Sulphated lime, or ſelenite . . .	44
Muriated ſoda	1170
	1285

G.

Brine of the ſecond graduation.

Specific gravity 1076.

Fifty cubic inches, evaporated, gave a reſidue of 1615 grains. This was decompoſed into:

Muriat of lime	75 grains.
——— *of magneſia*	2
Carbonat of lime	3
Selenite	48
Muriat of ſoda	1487
	1615

H.

Brine of the third graduation.

Its ſpecific gravity amounted to 1086.

Fifty cubic inches of it have left, upon evaporation, 1850 grains of a dry reſidue, containing :

Muriat of lime	82	grains.
——— *of magneſia*	3	
Carbonat of lime	3	
Sulphat of lime (ſelenite)	52	
Muriat of ſoda (common ſalt)	1710	
	1850	

The ſalt obtained by boiling from theſe *graduated* brines is of two ſorts, of which the one is deſtined for *foreign*, and the other for *home* conſumption. The *firſt* conſiſts, for the moſt part, of conſiderably large, four-ſided, hollow cryſtals, compoſed, in a funnel-like manner, of ſimple cubes of muriated ſoda. Such cryſtals are always formed on the ſurface of the brine, when they can evaporate without agitation. The *ſecond* ſort is externally diſtinguiſhed from the preceding by ſomewhat ſmaller and leſs regular cryſtals.

I.

Common ſalt for exportation.

One pound of it, that had been completely deſiccated with the aſſiſtance of heat, was pulverized, and then

amined by the method above-deſcribed. It conſiſted
:

	Oz.	drach.	gr.
Moiſture, expelled by the drying .	—	3	—
Accidental impurities, and ſand . .	—	—	10
Muriated lime	—	—	25
Selenite	—	1	30
Pure muriat of ſoda	15	2	55
	16 Ounces.		

K.

Common ſalt for home-conſumption.

One pound of it, treated as the laſt, contained :

	Oz.	drach.	gr.
Moiſture	—	4	30
Accidental impurities . . .	—	—	18
Muriated lime	—	—	30
Selenite	—	1	35
Pure muriat of ſoda . . .	15	—	7
	16 Ounces.		

L.

Mother-water.

The mother-brine proved to be of conſiderable ſpecific ravity ; namely, 1218.

Fifty cubic inches of it, when evaporated, yielded 5440 rains of dry ſalt, which I divided into two parts, ſubjectg each to a ſeparate examination.

1) 2720 grains, or one half of the ſalt obtained from mother-water, and decompoſed after the manner ſo of mentioned, gave:

Muriated calcareous earth . . .	330 grains,
——— *magneſian earth* . . .	420
Sulphated calcareous earth . . .	50
Common ſalt	1920
	2720

2) The other half of the ſalt, afforded by 50 cubic inc of the mother-water, I re-diſſolved in water, and eva rated the ſolution to the point of cryſtallization. I obtai from it, at five ſucceſſive ſhootings, 4 ounces and drachms of cryſtallized muriated ſoda, but which was ſ contaminated by the mother-water which adhered. For t reaſon, I diſſolved it once more in water, and cryſtalli it anew; by which treatment I then obtained 3 oz. 7 of pure common ſalt. By this it was rendered evide that every cubic foot of that mother-water, if treated in ſimple way of cryſtallization, would ſtill afford 16 or pounds of pure muriat of ſoda. The mother-water of b cryſtallizations was diluted with water, and its earthy porti precipitated by ſoda, weighed 544 grains, when waſhed ignited. This precipitate conſiſted of *calcareous* and *m neſian* earth; which I ſeparated, by ſaturating the maſs w ſulphuric acid. When the ſulphat of magneſia had b filtered off from the ſulphat of lime which was formed at ſame time, I decompoſed it by means of ſoda. The m neſia, then obtained in a pure ſtate, and weighing grains, by treating it with muriatic acid, was converted i muriat of magneſia, which, evaporated to dryneſs, amoun to 420 grains; exactly as it did in the foregoing proceſs.

This portion of muriated magneſia, contained in the mother-water along with the muriated lime, and exceeding the latter in quantity, deſerves particular notice. In both brines, in the *graduated* as well as the rough, the muriated magneſia amounted only to the 30th or 40th part of the muriated lime; in the mother-water, on the contrary, the quantity of the firſt exceeds the latter nearly by one fourth part. The cauſe of this ſeems to lie in the following circumſtance:—It is cuſtomary, at Königsborn, to preſerve the mother-water of 4, 5, or more boilings in the boiler. At any ſubſequent boiling, therefore, a ſtronger heat is required, to promote the cryſtallization of the ſalt; and when, in this caſe, a part of the bottom of the boiler becomes dry, a portion of the muriated lime is then decompoſed, and its earthy baſis becoming *free*, increaſes the calcareous earth in the *ſchlot*, or incruſtation (*pfannenſtein*) of the veſſel: but the muriatic acid eſcapes in vapours, as may diſtinctly be perceived by the ſmell.

M.

Incruſtation of the boiler.

One Pound of it, pulverized and dried in a gentle heat, was boiled with 12 lb. of water. The filtered ſolution was next evaporated to dryneſs, and the ſalt obtained was treated in the method all along mentioned. When the undiſſolved, grey-white, earthy reſidue was examined, it proved to be a mingled maſs of ſulphat of lime, of *carbonated lime containing a little iron*, and of a ſandy *ſiliceous earth*.

The proportion of theſe conſtituent parts to each other was found to be as follows:

Oz.

	Oz.	drach.	gr.
Moiſture	1	6	—
Muriated lime	—	1	10
———— *magneſia*	—	—	10
Muriat of ſoda, with a ſcarcely perceivable *trace of ſulphated ſoda*,	4	4	40
Carbonat of lime	1	2	30
Sandy ſiliceous earth	—	3	30
Sulphat of lime (ſelenite) . . .	7	6	0
	16 Ounces.		

N.

Dornenſtein.

(That is, the earthy and ſaline incruſtations formed on the bruſh-wood in the *graduating* houſes.---Tranſl.)

The *Dornenſtein* of theſe ſalt-works conſiſts of a dark-brown, compact, indurated, ſtony cruſt, ſimilar to the incruſtations at *Carlsbad.*

1.) Of this I boiled *two ounces*, reduced to powder, with a ſufficient quantity of water. This, however, would diſſolve but little; for, after evaporation, there remained only four grains of common ſalt, mixed with iron and ſelenite.

2.) The powder of the ſtone which remained after boiling was ſaturated with muriatic acid. The ſolution was attended with great efferveſcence, and, towards the end was promoted by heat. When filtered, it left ſelenite behind.

3.) The

3.) This muriatic ſolution, combined with cauſtic ammoniac, depoſited a quantity of iron in a flocculent form; the weight of which, firſt aſcertained when collected and ignited, was afterwards reduced to that of carbonated iron.

4.) The ſolution, now perfectly colourleſs, afforded carbonat of lime, by the addition of ſoda.

The proportion of the ingredients in theſe two ounces, or 960 grains of the mentioned *Dornenſtein*, was:

Impure common ſalt . . .	4 grains
Selenite	25
Carbonated oxyd of iron . .	92
——— *calcareous earth* .	828
Moiſture	11
	960

What corrections, or improvements, might be made in the boiling of ſalt in the *ſalt-works* at *Königsborn*, in conſequence of the analyſis here communicated of the ſalt-brines, or ſprings of that place, and their products, I leave to the judgment of practical *halurgiſts*, or ſalt-makers.

But the advantage which the ſcience may derive from the performance and collection of theſe and ſimilar analyſes, cannot be doubted: thereby, not only the ſum of our obſervations hitherto collected, on the nature and conſtituent parts of ſalt-ſprings in general, will be rendered more complete and certain; but likewiſe the knowledge of the laws of elective attractions of bodies, in particular, will be in-

XXVII.

CHEMICAL EXAMINATION OF *SPINELL.*

THE *ſpinell* ſeems to belong to thoſe ſpecies of ger which the antients underſtood by the name *Hyacinth*; they do not aſcribe to it the yellowiſh red colour, poſſeſ by our modern hyacinth, but a light violet-red, and alſ roſe-red. Pliny[*], for example, ſays:—" *Multum ab a thyſto diſtat hyacinthus, tamen e vicino deſcendens. Differ tia hæc, quod ille emicans in amethyſto fulgor violaceus, di tus eſt in Hyacintho.*" *Epiphanius* enumerates five ſpec of hyacinth, the *third* of which he calls NATIBOS[†], ſta by *Salmaſius* to have been of a colour, *qui inter roſeum et dilutiorem.* That the ſtone, now called hyacinth, been miſtaken for the hyacinth of the antients, was pro bly occaſioned by the following paſſage of *Pliny*[‡] " *Hyacinthos Æthiopia mittit et chryſolythos aureo colore tr lucentes.*" But if in conſequence of a ſounder critic the context be read thus:—*Marceſcens celerius nominis flore hyacinthus. Æthiopia mittit et chryſolithos*, &c. i obvious, that the *aureus colour* is referred to the chryſol which, as is well known, is the *topaz* of our days, that it has nothing to do with the *hyacinthus* of the prec ing ſentence. In this way, alſo, another apparent c tradiction in Pliny is removed.

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[*] Lib. xxxvii. cap. 9.

[†] From the Arabic word, *Natif*, a red crayon colour. *See J de Laet de Gemmis et Lapidibus.* Lugd. Batav. 1647.

[‡] Loc. cit.

The reader likewiſe knows that the ſpinell has been hitherto ranked along with the *ruby* as its ſecond ſpecies, ſo that the firſt ſpecies of that genus has included the true genuine ruby. But ſince *Rome de l'Iſle*[*] has directed the attention to the different form of cryſtallization of thoſe two ſtones: obſerving that the cryſtals of the genuine ruby of *Pegu* are oblong, double, hexahedral pyramids, modern mineralogiſts have, upon this ground, ranked the *ruby* under the ſapphire, as a red variety of it, and introduced the *ſpinell* as a diſtinct genus; which ſeparation is alſo ſuggeſted by the difference of its hardneſs and ſpecific gravity.

Beſides theſe diſtinctions, the nature of the fracture alſo might ſerve to diſcriminate the genus. For the texture of the ſpinell is lamellar, in triple tranſverſe laminas; the ſapphire, on the contrary, exhibits in every direction only a flat conchoidal fracture[†].

Yet the ſureſt way to decide on this point would be by chemical analyſis; which, however, with reſpect to the ruby cryſtallized in hexhedral pyramids, or the red ſapphire, can be at preſent but little hoped for, as it is ſo ſeldom met with in its rough ſtate.

The original figure of ſpinell is the octahedron, or double four-ſided pyramid. This cryſtalline figure is frequently found perfectly regular, but as often ſubject to many variations, which have been detailed and deſcribed with great diligence, and uncommon accuracy, by Abbé *Eſtner*[‡].

No leſs variable is the colour of the ſpinell; as it paſſes through almoſt all the ſhades of the red. This variation

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[*] *Criſtallographie*, tom. i. page 213.

[†] *Eſtner, Mineralogie*, II. B. I. Abth. S. 96, 97.

[‡] *Ibidem*, page 73. ſeq.

colour has induced jewellers, or dealers in gems, to
divide the genus of ruby, beſides the *genuine ruby*, into
andin, *ſpinell*, *ballaſs*, *and rubicell*, as they uſually do.

The red colour of this gem is not only very fixed, or
manent in the fire, but its pale variations are even ſtill
e heightened by means of a careful ignition. This pro-
ty the inhabitants of Ceylon know how to employ to
antage, according to the teſtimony of *Julius Scaliger*;*
, perhaps, on this dexterity of art depends the ama-
gly high and magnificent colour which we admire in
, poliſhed rubies, but do not perceive in the rough, uncut
es.

o the more uncommon variations of colour belong:
he ſpinell, quite *colourleſs*, and as limpid as water, of
ch Mr. *Macie*, in London, poſſeſſes a perfect octahe-
n in his collection of cryſtals; 2. the *ſapphire-blue* ſpi-
, in the collection of *Francis Greville*, Eſq.; and 3.
green ſpinell, the property of *J. Hawkins*, Eſq. like-

her analytical proceſs. The reſult of this has taught me, hat on the firſt analyſis of the ſpinell, I had thoroughly overlooked one of its conſtituent parts, which I did not ſuſpect in it, and which is *magneſian-earth*. Among the various experiments, inſtituted for accurately determining the proportion of this newly diſcovered ingredient, I ſelect that in particular, which led the neareſt to fulfilling this object.

a) *One hundred* grains of rough ſpinell from Ceylon, in picked cryſtals, previouſly pounded to a coarſe powder in the ſteel-mortar, were triturated with water to an impalpable powder in the grinding-diſh made of flint. After the powder of the ſtone, which was again dried, had been gently ignited, it ſhewed an increaſe of weight of nine grains, originating from the particles abraded from the ſubſtance of the grinding-veſſel.

b) I then ſtrongly digeſted that powder with two ounces of muriatic acid. When the acid had been evaporated nearly to dryneſs, I diluted the maſs with water, threw it upon the filter, and ſaturated the yellow muriatic ſolution with cauſtic ammoniac. A brown flocculent *oxyd of iron* fell down, which, collected and ignited, weighed 1¼ grain.

c) The liquor ſeparated from that precipitate was concentrated by evaporation, perfectly neutralized with muriatic acid, and, laſtly, combined with diſſolved oxalat of pot-aſh (ſalt of wood-ſorrel). In conſequence of this, oxalat of lime precipitated; which, when carefully collected, and heated to redneſs in the cavity of a compact piece of charcoal, with the aſſiſtance of the blow-pipe, afforded three fourths of a grain of lime, or pure *calcareous earth*. This laſt, diſſolved in nitric acid, and treated with the ſulphuric, produced ſelenite, or ſulphated lime.

) Upon the powder of the ſtone, extracted by the mu-
ic acid, was poured ten times its quantity of alkaline
, one half of which conſiſted of cauſtic alkali; which
ture being firſt evaporated to dryneſs, in a ſilver-veſſel,
n a ſand-heat, was afterwards ignited during the ſpace of an
. When the maſs had been again ſoftened with hot
er, it left on the filtering paper 54 grains of an iſabella-
ow reſidue when dried in the air.

) Theſe 54 grains were a ſecond time mixed, and in-
ated with a tenfold quantity of the ſame cauſtic lixivi-
, and afterwards ignited. Upon which, the maſs, ſoft-
l again with water, depoſited a reſidue of a fine pulve-
nt form, weighing 43 grains, when dried in the air.

) I then neutralized the yellow alkaline ſolution (*d*)
(*e*) by means of ſulphuric acid, and by affuſing more
, made a clear ſolution of the precipitate, which then
ed. Carbonat of pot-aſh, added in a boiling ſtate, threw
n from it a precipitate of a very great bulk, which,

h) The portion taken up by the cauſtic pot-aſh in the alkaline ſolution (*g*), was precipitated by means of ſulphuric acid. But it diſſolved again in the acid, when added to exceſs, and was afterwards precipitated by boiling with mild, or carbonated alkali. This precipitate, previouſly waſhed, was once more diſſolved in ſulphuric acid.

i) The whole of the ſulphuric ſolutions, obtained at (*f*, *g*, *h*), was evaporated to a ſmaller compaſs. The gelatinus conſiſtence, into which it congealed, ſhewed that a ſeparation of ſiliceous earth had taken place. It was therefore largely diluted with water, digeſted, and the ſilex collected upon the filter.

k) This done, the ſulphuric ſolution was put in a ſtate to cryſtallize, by dropping into it a ſolution of acetite of pot-aſh *, and evaporating it ſlowly. It yielded at firſt regular and pure cryſtals of alum. But as the ſolution aſſumed a green colour towards the end, I combined it with Pruſſian alkali. A trifling precipitation enſued, of which the *oxyd of iron* could not be eſtimated more than at one fourth of a grain. The ſolution, being now freed of its ferruginous ingredient, was next decompoſed, in a boiling heat, by carbonated pot-aſh; and the precipitate, when diſſolved anew in ſulphuric acid, was brought to a final cryſtallization; after which the ſulphat of alumine then obtained was added to the foregoing.

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* *Note.* In order to add the vegetable alkali in the juſt proportion requiſite to promote the cryſtallization of the ſulphated alumine, I find it at preſent moſt convenient to employ that alkali in a ſtate of ſaturation with acetic acid. By this manner I avoid the danger of decompoſing a part of the alum juſt forming, by the quantity of alkali, that may eaſily happen to be added in exceſs.

I now proceeded to the analyſis of the 43 grains, that
left undiſſolved by the cauſtic alkaline lye (*e*). Theſe
ily diſſolved in dilute ſulphuric acid, leaving ſome ſili-
s earth behind. The ſolution, ſeparated from this
was then combined with a ſmall portion of acetated
aſh, and expoſed to ſpontaneous cryſtallization by exha-
n in the open air. At firſt there yet appeared ſome foli-
cryſtals of alum; but afterwards it entirely ſhot into
hat of magneſia (Epſom ſalt).

) To ſeparate the ſulphated magneſia, thus obtained,
n the admixed ſulphat of alumine, it was ſtrongly ignited
a porcelain-veſſel during half an hour, and the ſaline
s afterwards ſoftened in water, and filtered. The alumi-
s, or argillaceous earth, ſeparated by this management,
afterwards diſſolved in ſulphuric acid, and in the proper
ner cryſtallized into concrete alum.

) The pure ſolution of the ſulphated magneſia was pre-
tated in a boiling heat by means of vegetable alkali-

heat of ebullition decompoſed by carbonated alkali from tartar. The *aluminous earth*, thus obtained, lulcorated with water, and dried in a moderate weighed 221 grains. But, after being purified by with diſtilled vinegar, and ſubſequent ſaturation moniac, and being again edulcorated, and at laſt for half an hour to an intenſe red heat, it weighed han 74½ grains.

ien ignited, for half an hour, the whole of the *ſilice-* collected from (*i*, *l*, *o*). Its weight was 24½ grains. ubtracting the nine grains which had been abraded flint-mortar (*a*), there remain 15½ grains belong- ſpinell.

his analyſis it follows, that the conſtituent parts of *l* in the *hundred* are:

ine	*p*)		74,50
. . . . .	*q*)		15,50
neſia	*n*)		8,25
l of iron . . .	*b*)	1,25	. . . 1,50
	k)	0,25	
. . . . .	*c*)		0,75
			100,50

eaſon why, in this inſtance, there appears in the e weights an exceſs of half a grain, rather than a oidable in the uſual courſe of ſuch proceſſes, is that the ignition was not powerful enough to thoſe ingredients that high degree of dryneſs, at ſtone poſſeſſes in its natural, undecompoſed

With regard to another analytical proceſs made wi ſpinell, and of which it would be ſuperfluous to give a d tailed deſcription, as it only ſerved to pave the way to t foregoing, I ſhall here merely relate the following phe nomenon.—When the coheſion of the parts which conſti that ſtone had been looſened by alternate treatment w cauſtic potaſh and muriatic acid, I introduced the e precipitated by ammoniac from the muriatic ſolution, cauſtic alkaline lye. It diſſolved therein for the moſt but not wholly. The undiſſolved remainder was upo diſſolved in muriatic acid; and when the ſiliceous which then appeared, had been removed, the fluid again evaporated to a ſmaller volume.

After ſome days ſtanding, there appeared in it a qu of ſmall cryſtalline groups, conſiſting of clear, and ingly quadrilateral, ſomewhat flattened, little column greater number of which were joined by two and t the form of an X, but the others in groups of thr more, in a ſtellated manner.

Theſe cryſtals readily diſſolved in water. The tate, thrown down by cauſtic ammoniac, was of a brown, on account of ſome portion of iron, which hered. It was then diſſolved in ſulphuric acid, a new combination was again ſet to cryſtallize in the manner. At firſt there appeared cryſtals of alum; remainder of the ſolution gradually ſhot into four- lumnar cryſtals of ſulphated magneſia.

It is this cryſtallization of *magneſia*, mixed with in muriatic acid, which I think worth remarking.

XX

XXVIII.

CHEMICAL EXAMINATION

OF THE

EMERALD from Peru.

emerald is one of the beſt known gems, and it has
eckoned even in remote antiquity among the moſt
ed precious ſtones, on account of its rich green co-
ſo grateful to the eye. *Pliny* enumerates *twelve*
of it, and conſiders the *Scythian*, *Bactrian*, and
an, as the moſt eminent. However, it can hardly
bted, but that, in thoſe days, various eſſentially dif-
ſpecies of ſtones of a green colour were compriſed
that name; as is frequently done in our days. The
ıtance of Mineralogiſts with the genuine emeralds,
were furniſhed by the parts of the globe the longeſt
, ſeems at preſent to be almoſt entirely obliterated by
miliarity with thoſe which are found, though ſpa-
in the provinces of *South-America*, and *principally*
u.

'or the following analyſis I made uſe of the crude,
lized emerald, of a high graſs-green colour, from
. I pounded it in a ſteel-mortar to a coarſe powder,
turated *one hundred* grains of that powder very finely

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r the ſpecimen of emerald ſacrificed to this analytical pro-
am indebted to the liberal kindneſs of Prince *Dimitri Gal-*
whoſe zeal for the ſtudy of Mineralogy is moſt honourably

with water, in the flint grinding-diſh. After gentle ignition, I found its weight increaſed by about 1½ grain.

b) The powder of the ſtone was covered, and ſeveral times digeſted in a ſtrong heat, with muriatic acid; which immediately acquired a yellow colour. After having again filtered off the acid, I ſaturated it to exceſs with cauſtic ammoniac; and by this management there ſeparated light, brown flocculi, which, collected and ignited, weighed half a grain, and were *oxyd of iron*. The fluid was next evaporated to a part, and treated with carbonated ammoniac. But it continued clear, and thus ſhewed, that it contained no calcareous earth.

c) *Fourteen* drachms of cauſtic alkaline lye, made of ſeven drachms of the ſalt diſſolved in as many of water, were then affuſed upon the powder of the ſtone extracted by the muriatic acid (*b*); and after the maſs had been previouſly evaporated to dryneſs in a ſilver-crucible, I ſubjected it to a red-heat for half an hour. However, it would not fuſe, but appeared, after ignition, in an intumeſced, friable ſtate, and of a white colour.

d) On being ſoftened with water, and treated with abundance of muriatic acid, it afforded a very limpid ſolution, from which the earthy ingredient was precipitated by carbonated pot-aſh, with the aſſiſtance of heat. The precipitate had a granular form; and when finely ground, the greateſt part ſeemed to diſſolve in muriatic acid, which was poured upon it. But as ſoon as the mixture had been expoſed to a digeſting heat, it coagulated to a tranſparent thick jelly. When diluted, and digeſted with more water, it depoſited ſiliceous earth to the amount of 67 grains, after waſhing and ignition. This earth was then mixed with four parts of carbonated potaſh, and ignited to an incipient fuſion, in a crucible made of ſilver. Upon the maſs, re-diſſolved in water, which afforded a ſomewhat turbid ſolution, I poured muriatic acid to an exceſs of ſaturation, and digeſted them together. The *ſiliceous earth*, which I thus recovered, was now perfectly pure, and weighed 63½ grains, after having ſuſtained a red heat.

e) The muriatic ſolution, ſeparated from this ſilex, together with the preceding (*b*), was ſaturated with an over-proportion of cauſtic ammoniac. The paſte-like precipitate, thence ariſing, was immediately removed, and the filtered liquor combined with carbonat of ammoniac; which, however, would throw down nothing more. Sulphuric acid quickly diſſolved this precipitate. By the addition of a little acetite of pot-aſh, the whole of the ſolution yielded cryſtallized alum, with the exception of ſome *ſilex*, which ſtill ſeparated, and weighed 4½ grains, after ignition.

f) From the above ſulphat of alumine (*e*) being re-diſſolved in water, I precipitated the argil by carbonated pot-aſh. When the earth had been again deſiccated, I poured upon it diſtilled vinegar; put the whole in a warm place; ſaturated the acetic acid with cauſtic ammoniac; and, laſtly, filtered the mixture. What remained of the fluid ſuffered no alteration, either by carbonat of ammoniac, or by carbonat of ſoda. The *aluminous earth*, now obtained in a ſtate of purity, was firſt dried, then ignited, and found to weigh 31¼ grains.

Therefore, the conſtituent parts of *one hundred* grains of *Peruvian emerald*, here decompoſed, yielded:

Silex	*d*) .	63½ grains	
	c) .	4¼	
		67¾	
Subtract . . .	*a*) .	1½	
		66¼ . . .	66,25
Alumine, or argil .	*f*)		31,25
Oxyd of iron . .	*b*)		0,50
			98

XXI

XXIX.

CHEMICAL EXAMINATION

OF THE

BOHEMIAN GARNET.

THE denomination *garnet* ſerved to the elder Mineralo-iſts as a generic, or *collective-name*, in which they included lmoſt all roundiſh cryſtalline forms, encompaſſed by de-ned lateral facets, or all the ſpecies of ſtones, of, as iey were called, a polyhedral cryſtallization. At preſent, owever, the *generic name*, *garnet*, has been confined within arrower limits; for the *white* garnet, as well as the *black*, ive been juſtly removed from it, and arranged as diſtinct enera: the firſt under the name *Leucite*; the ſecond under at of *Melanite*.

It may alſo be foreſeen, that ſeveral other foſſils now aſſed as ſpecies, or as varieties of the garnet, beſides thoſe ſt mentioned, will in time receive another place in the ſtematic arrangement of minerals: in conſequence of ore accurate obſervations concerning the deviation, not ly with regard to their external appearance, but likewiſe ith regard to their chemical conſtituent parts, by which ey are diſtinguiſhed from the true and ſtrictly determined incipal genera, to which laſt the Bohemian garnet princi-ally belongs.

The *Bohemian garnet*, (whoſe occurrence, method of rocuring it from the mines, and external characters, are oo well known to require any farther illuſtration in this place),

place), when weighed in water, loſt 269 parts of 1000 its abſolute weight; its ſpecific gravity therefore is = 3,7

It fuſes by itſelf alone in a proportionate intenſity heat*. The iron which it contains is reduced to the re line ſtate, when expoſed to the action of fire in the ch coal-crucible. From 100 grains of Bohemian garnet obtained a button of iron, of 10⅞ grains weight.

In order to find out its conſtituent parts, I ſubjected it the following experiments.

a) I ground *two hundred* grains of Bohemian garn previouſly pounded in the ſteel-mortar, with water, to ſubtle powder, in the flint triturating diſh. When dri and gently ignited, the powder of the ſtone was found i creaſed in weight by ſeven grains. I inſpiſſated it with a li vium, made of 600 grains of cauſtic pot-aſh, in a ſilv crucible, and ignited it afterwards for half an hour. T ignited maſs was then ſoftened with water, lixiviated, a filtered. The filtered lixivium was of a light graſs-gree but ſoon loſt that colour, and became light-brown. I expoſure to a warm temperature, it depoſited, after 24 hou an *oxyd of manganeſe*, which, collected in a porcelain-c amounted to about half a grain. On fuſing it upon ch coal, with a neutral phoſphat, and covering it with ni of pot-aſh, the ſalt exhibited, after detonation, a dark v let-red colour, mingled with green ſpots.

b) The alkaline lye was then ſuper-ſaturated with muri acid, and evaporated nearly to dryneſs. After re-diſſolv the ſaline maſs in water, *ſiliceous earth* was depoſited, wh weighed 11 grains, after edulcoration and ignition. W this had been ſeparated, ſome *aluminous earth* was thrown down by carbonated ſoda from the muriated ſolution. As the remaining liquor ſtill appeared of a yellow tinge, it was again evaporated to a dry ſalt. But this likewiſe had a citron-yellow colour, and again afforded a yellow ſolution with water; from which, however, nothing could be farther ſeparated, by any means whatever.

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* See Eſſay I. No. 39.

c) The lixiviated powder of the garnet had the colour of a light-brown iron ochre. To this I added the ſmall portion of alumine (*b*), and treated it with muriatic acid, with which it immediately formed a golden-yellow ſolution. When this laſt had been evaporated, in a ſand-heat, to a gelatinous conſiſtence; it was again largely diluted with water, once more digeſted and filtered. The *ſiliceous earth*, being well lixiviated, and heated to redneſs, weighed 76 grains.

d) Cauſtic ammoniac threw down from the muriatic ſolution a copious brown precipitate; which, after being collected on the filtering paper, was waſhed, and dried in a moderate warmth.

e) The colourleſs fluid, remaining after the precipitation with cauſtic ammoniac (*d*), was evaporated in part, and combined with carbonated ſoda. By this management, carbonat of lime fell down, which, after drying, weighed 12¼ grains, equal to ſeven grains of *ignited calcareous earth*, or burnt lime.

f) I then divided the brown precipitate, obtained by means of ammoniac (*d*), into two equal parts.

One half of it I expoſed to ſtrong ignition in a covered crucible, and found, after this, its weight to amount to 55 grains.

g) The other half I diſſolved again in muriatic acid, diluted the ſolution with a ſufficient quantity of water, and precipitated its portion of iron by Pruſſian alkali. The ſeparation of the dark-blue precipitate being accompliſhed, I precipitated the ſolution, now freed from iron, by means of carbonated ſoda, and in a boiling heat. The quantity of the white, looſe earth thus obtained amounted, after waſhing, drying, and ignition, to 38½ grains.

From this it was manifeſt, that the proportion of *oxyded iron*, ſeparated by pruſſiated pot-aſh, amounted to 16½ grains.

h) The above 38½ grains of ignited earth (*g*), were then diſſolved in ſulphuric acid, and made to cryſtallize, after the addition of a proper quantity of acetated pot-aſh. The firſt ſhootings yielded regular cryſtals of alum. But the laſt ſhewed, by the oblong, four-ſided columnar figure of its cryſtals, that it was ſulphat of magneſia.

i) But as the ſulphat of magneſia could not be ſeparated from the alumine with ſufficient accuracy, I ſubjected the whole of the ſaline maſs to ſtrong ignition for an hour; after which I liquefied the ignited maſs with water, and combined the mixture, at a raiſed temperature, with powder of calcined oyſter-ſhells, added in ſmall portions, until the ſolution no longer reddened paper tinged with litmus. The filtered ſolution taſted now like pure ſulphat of magneſia, and, when ſet to cryſtallize, I obtained from it 69 grains of this neutral ſalt. However, on being re-diſſolved in water, it ſtill depoſited two grains of ſulphated lime: hence its true quantity amounted to 67 grains.

k) To recover from it the earth in a ſeparate ſtate, precipitated the ſolution, in a boiling heat, by carbonat of ſoda. The *magneſian earth*, waſhed and dried, weighed 23¼ grains; but when heated to incandeſcence in a covered crucible, and kept in that ſtate during half an hour, it weighed but 10 grains.

By ſubtracting theſe 10 grains of magneſia from the above 38½ grains (*g*), there remain 28½ grains for the aluminous earth.

One hundred grains of *Bohemian garnet* conſiſt, therefore, of:

Silex	*b*)	5½	
——	*c*)	38	
		43½	
and deducting	*e*)	3½	
		40	40,
Alumine	*k*)		28,50
Oxyd of iron	*g*)		16,50
Magneſia	*k*)		10,
Lime	*e*)		3,50
Oxyd of manganeſe	*a*)		0,25
			98,75

XXX.

CHEMICAL EXAMINATION

OF THE

ORIENTAL GARNET.

THE *Oriental*, or *Sirianic Garnet* [*], is diſtinguiſhed from the *Bohemian*, both by its violet-red colour, and by its ſpecific gravity; which is = 4,085. This higher weight of it depends on the greater proportion of iron which it contains, and which is ſo conſiderable, that, by mere fuſion in the charcoal-crucible, I obtained from 100 grains of the oriental garnet a fine button of iron, of 23 grains. It likewiſe, when fuſed alone, in a crucible made of clay, runs into an enamel glaſs of a blacker colour than that of the Bohemian garnet [†].

a) *Two hundred* grains of oriental garnet, previouſly bruiſed into ſmall pieces, in the ſteel mortar, acquired eight grains additional weight from the ſubſtance of the flint-grinding diſh, in which they were finely levigated with water. The powdered garnet was put in a cauſtic lye, in which the alkaline ingredient conſtituted thrice the weight of the powder; and, with this, it was inſpiſſated to a dry maſs, in a crucible made of ſilver. It was next ſubjected to red-heat during half an hour; and when the ignited maſs had again been ſoftened with boiling water, the powder of the ſtone, ſeparated from the decanted liquor, was lixiviated and dried.

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[*] Rather *Sirianic*, than Sirian garnet: from *Sirian*, a town in *Pegu*, now deſtroyed.

[†] See Eſſay I. No. 40.

b) The alkaline lixivium was of a bright graſs-green. But it was ſoon deprived of that colour by expoſure to a warm temperature, at the ſame time that it depoſited an *oxyd of manganeſe*, impregnated with iron, in a brown flocculent form, and weighing about ½ grain when ignited.

c) The alkaline lye was now devoid of all colour. It was ſaturated with muriatic acid, and evaporated in part. A light flocculent earth then ſeparated, but part of it diſſolved again upon ſuper-ſaturation with muriatic acid. The inſoluble reſidue conſiſted of *ſiliceous earth* of 9½ grains after ignition. That part of the earth, which had been re-diſſolved by the exceſs of acid, was then ſeparated afreſh by carbonat of pot-aſh. After ignition, this earth weighed 4½ grains; and, upon being tried by ſulphuric acid, it proved to be pure alumine, or *aluminous earth*.

d) The edulcorated powder of the ſtone (*a*), which had a cinnamon colour, and a very incoherent form, was moiſtened with water, and treated with muriatic acid, in which it rapidly diſſolved, without leaving any reſidue. The liquor was limpid, and of a golden-yellow. But, on being ſubjected to evaporation, on a ſand-bath, it coagulated into a ſemi-tranſlucid, gelatinous ſubſtance; which had a deep golden-yellow colour, and was again digeſted for a while along with water that was poured upon it, and with repeated ſtirring. When, after this, it had been brought upon the filter, it left *ſiliceous earth* in a ſwelled ſtate; which, being thoroughly edulcorated by a frequent affuſion of hot water, and deſiccated, weighed 104 grains, but only 70 grains when heated to redneſs.

e) To the muriatic ſolution, diluted with the waſhings of the ſilex (*d*), I added cauſtic ammoniac in exceſs. It gave a copious brown-red, much intumeſced precipitate, the quantity of which, after waſhing and drying, amounted to 190 grains.

f) The colourleſs fluid remaining from this laſt proceſs was firſt combined with as much muriatic acid as was requiſite to ſaturate the predominant portion of ammoniac, and then with carbonated ſoda. But as this produced no turbidneſs, I evaporated the whole of the liquor to a dry ſaline maſs, which being re-diſſolved in a little water, I tried it once more with carbonat of ſoda. The mixture ſtill continuing clear, ſhewed, that it contained no other conſtituent part.

g) Thoſe 190 grains of the brown-red precipitate, obtained at (*e*), were divided into two parts.

One half was ignited, and then found to weigh 61 grains. I poured upon it ſulphuric acid, evaporated it to dryneſs; and after having ſtrongly ignited the ſaline maſs for two hours, in a melting pot, I extracted it with water, and combined the filtered, clear fluid with carbonated ſoda, in a heat of ebullition. There ſeparated, however, ſome ſcarcely perceptible flocculi of aluminous earth only, without any trace either of lime, or of magneſia.

h) The other half of the precipitate was diſſolved in muriatic acid; and, after ſufficient dilution with water, combined with Pruſſian alkali, added ſucceſſively, till all the ferruginous parts were ſeparated. The blue precipitate of iron weighed 185 grains, when waſhed and deſiccated. After being ſtrongly ignited in a covered crucible, there remained 72 grains of iron attractible by the magnet. One part

art of it was aſſayed for manganeſe by fuſion with a phoſphated alkali; but it gave no indication of this metal.

i) The ſolution being now freed from the iron (*b*), it was decompoſed in a boiling heat, by carbonated ſoda, and the precipitated earth lixiviated, and heated to redneſs. It weighed 25 grains; whereby, ſubtracting it from the 61 grains, obtained from the firſt half of the precipitate (*e*, *g*), the portion *of iron*, contained in 100 grains of this garnet, is found to be 36 grains.

k) When the above 25 grains of ignited earth (*i*) had been diſſolved in ſulphuric acid, and, after the addition of acetated pot-aſh in due proportion, was ſet to cryſtallize, they afforded to the end cryſtals of pure *ſulphat of alumine*.

It reſults from this decompoſition, that the conſtituent parts of the *oriental garnet* are in *the hundred:*

Oxyd of iron	*i*)		36
Silex	*c*)	4¾	
——	*d*)	35	
		39¾	
Subtract	*a*)	4	
		35¾	35,75
Alumine	*c*)	2¼	
——	*k*)	25	
		27¼	27,25
Oxyd of manganeſe	*b*)		0,25
			99,25

XXXI.

CHEMICAL EXAMINATION OF *VESUVIAN*.

FIRST SECTION.

Veſuvian; from the Mountain Veſuvius.

AMONG the different ſorts of ſtones, which the Mo tain Veſuvius brings up from the bowels of the ea in their native unaltered ſtate, that cryſtalline foſſil may reckoned, which the inhabitants of Naples call the *Veſu gem.*—Mineralogiſts had variouſly claſſed it with ſh chryſolite, hyacinth, topaz, &c. and by the adjecti *veſuvian*, or *volcanic*, diſtinguiſhed it as a variety of above mentioned gems; till *Werner* eſtabliſhed it as a tinct genus of ſtones, and gave it the name, *Veſuvian*; till then, it was found on Mount Veſuvius only.

An oryctognoſtic deſcription of that foſſil is already with in various elementary treatiſes on mineralogy. T given by *Eſtner* * is particularly accurate and complete, which reaſon I direct the reader chiefly to it.

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* *Eſtner, Verſuch einer Mineralogie für Anfänger und Liebh* II. Band. Seite 177 ſeq.

A.

Examination in the dry way.

A ſmall piece of veſuvian, if ignited upon charcoal
e the blow-pipe, gradually rounds itſelf into a dark-
n, ſhining, opake globe, tranſparent only in ſplinters.

rax (borat of ſoda) diſſolves it by degrees, to a clear
brown, and ſomewhat bliſtered, or air-bubbled glaſs-
n.

is not, however, completely diſſolved by means of a
al phoſphat, for this only envelopes the particles of the
in the form of an amorphous frothy ſcoria.

e habitude of veſuvian is more remarkable, when
upon by a greater intenſity of heat in the charcoal-
le, which I have already communicated in the *firſt*
e eſſays, page 32, *n.* 103. The regular group of cryſ-
ation, there deſcribed, of the tender cruſt that ſur-
s the fuſed veſuvian, is a phenomenon according to
perience, the only one of its kind; and repeated ex-
ents have convinced me that it is conſtantly the ſame.

B.

Examination in the humid way.

decompoſe the veſuvian in the humid way, I picked
e beſt cryſtallized pieces of that variety which had a
colour, inclining to olive-green. Theſe were coarſely
red, and, by elutriation, freed from the greeniſh-white
licate lamellas of chlorite and mica, which ſtill ad-

hered.

hered. Placed upon the hydroſtatic balance, in this purified ſtate, its ſpecific gravity was 3,420.

a) *Hundred* grains of it were reduced to an impalpable powder, by levigation with water in the flint-triturating diſh. After gentle ignition, its weight was found to have encreaſed half a grain. Cauſtic alkaline lye, containing 300 grains of the ſalt, was then affuſed upon it, in a ſilver pot; and the mixture being firſt deſiccated in a ſand-heat, was next ſubjected to ſtrong ignition, during half an hour. Shortly before ignition the maſs acquired a vivid, light, graſs-green colour, but which was afterwards moſtly changed into a dirty olive-green.

b) The ignited maſs, while yet warm, was ſoftened with water, and thrown upon the filter. The filtered lixivium appeared of a pale greeniſh hue, but ſoon grew feebly brown-red. During gentle digeſtion, there ſubſided looſe, dark-brown, flocculent particles, leaving the lye colourleſs. As it could be foreſeen that they would not well ſeparate from the filtering paper, I collected them in a ſmall porcelain-veſſel, and dried them after edulcoration. By this treatment I obtained a dirty-brown powder, conſiſting of ¼ grain of *oxyd of mangane/e*. When conveyed into fuſed phoſphoric ſalt, it diſſolved in it clearly. The glaſs-globule thus formed, became by turns colourleſs and amethyſt-red, accordingly as I directed on it the inner or the outer point of the flame.

c) Upon the pale-brown, looſe veſuvian powder, ignited with cauſtic alkali (*a*), edulcorated and dried, I poured muriatic acid; which diſſolved it, with a little efferveſcence and left ſome *ſiliceous earth* behind.

d) Th

The yellowiſh ſolution, together with the waſhings
n reduced in bulk by evaporation, formed a clear coa-
m of a full golden-yellow. By diluting it again with
h water, and digeſting it for ſome time under repeated
tion, the *ſiliceous earth* was rendered diſpoſed to ſepara-
; I then collected it on the filter, and having added the
going portion (*c*), I ignited them both. They weighed
ther 36 grains.

Having thus freed the muriatic ſolution from all its
, I added to it cauſtic ammoniac in a greater quantity
its ſaturation required, and immediately gathered on
ilter the ſwelled precipitate thereby produced; which,
being perfectly lixiviated, was conveyed into a cauſtic
ine lye. It ſoon diſſolved in it upon the fire, leaving,
ever, a looſe, brown-red, muddy ſubſtance behind.

Both alkaline lixivia, that of (*e*), and that of (*b*),
then mixed, and over-ſaturated with ſulphuric acid,
he earth, firſt thrown down by the acid, was again
ved. Upon this I precipitated the earth by carbonated
ſh, edulcorated and re-diſſolved it in freſh ſulphuric acid,
g then a ſmall portion of acetated pot-aſh, and pre-
the ſolution for cryſtallization. It yielded cryſtals of
to the end, which I re-diſſolved in water, and preci-
ed its earthy portion by pot-aſh. The *aluminous earth*
obtained, when waſhed and ignited, weighed 19¼
s.

That fluid, which remained on the precipitation, ef-
d by cauſtic ammoniac (*c*), was then concentrated by
ration, and mixed with carbonated ammoniac. Sixty
s of *crude calcareous earth*, or carbonat of lime, fell
, which, in the ignited or pure ſtate, are equal to 33
s.

b) The brown reſidue, remaining from the ſolutio the argillaceous precipitate, in the cauſtic lye (*e*), was fo to weigh 13 grains upon exſiccation. Muriatic acid poured upon one half of it, and completely diſſolved Pruſſiat of pot-aſh, which was next added, produced a qu tity of Pruſſian blue, of a pure deep colour. Carbona ammoniac poured into the liquor, ſeparated from this la ſtill precipitated ſome aluminous earth, weighing 1 gra after ignition. The ſecond half of that brown reſid weighed five grains after expoſure to red-heat. From th it followed, that for the above-mentioned 13 grains of r ſidue, we muſt reckon 7½ grains of ignited *oxyd of iron*, a 2¼ of ignited aluminous earth. Some experiments ma with that oxyded iron, to detect whether it contained ma ganeſe, evinced it to be abſolutely free from this ingredien

Hundred parts of *veſuvian* from Mount *Veſuvius*, ther fore, contain:

Silex	*d*)	36 grains.	
Subtract	*a*)	½	
		35½	35,50
Lime	*g*)		33
Alumine	*f*)	19¾	
——	*b*)	2½	
		22¼	22,25
Oxyd of iron	*b*)		7,50
Oxyd of mangan.	*b*)		0,25
			98,50

SECOND SECTION.

Veſuvian from Siberia.

The foſſil, which I here introduce by that name, belo to the diſcoveries, as yet little known, made in Siberia

count

country ſo extenſive and abundant in remarkable mineral ſubſtances. It was diſcovered in the year 1790, by *Laxmann*, at the mouth of the river *Achtarugda*, where it falls into the ſtream *Wilui*. The firſt notice of it has been given by *Pallas*[*], under the name *Cryſtals of Hyacinth*, together with a delineation of ſome of theſe cryſtals, added to their deſcription.

Their external colour is a dark olive-green, which, in the interior ſurface, paſſes into the brown of *colophony* (the reſidue of diſtilled turpentine). Their form is a rectangular four-ſided column, with truncated edges; yet the facets of the truncations are ſometimes ſo large, that the cryſtals might almoſt be called eight-ſided priſms.

In the entire cryſtals both ends of the column are ſharpened off to a quadrilateral pyramid. The points, however, are more or leſs, and in part, very much truncated.

As to the ſize of theſe cryſtals, the breadth of the column, in the ſpecimens which I poſſeſs, is from $\frac{1}{2}$ to $\frac{3}{4}$ of an inch; and the length, not meaſuring the pointed termination, from $\frac{1}{2}$ to a whole inch.

The external luſtre is but moderate; the internal is brighter, and partaking of the greaſy gloſs. The fracture is of the imperfect, ſmall conchoidal kind, and diſtinctly exhibits, eſpecially the longitudinal one, a foliated texture.

This foſſil is opake in its entire cryſtals; but its fragments are tranſparent, and even ſemi-pellucid.

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[*] Pallas *Neue Nordiſche Beyträge*, vol. v. Petersburg and Leipzig, 1793, page 282.

earth, which I ſeparated. Cauſtic ammoniac was ded in exceſs to the yellow ſolution, which had been with the preceding (*b*), and it threw down a very in- ed light-brown precipitate, the ſeparation of which omplifhed in an inſtant.

hat precipitate, duly waſhed, and while yet moiſt, I with cauſtic alkaline lye. It was but ſlowly dif- n this menſtruum, and left a reſidue, the great volume ny appearance of which indicated, that it could not merely of oxyded iron, but was ſtill mixed with For this reaſon, I digeſted it with dilute muriatic nd evaporated it to a thickiſh maſs; which, being iluted with water, depoſited the *ſiliceous earth* con- n it.

auſtic ammoniac, added to this ſolution, now free l ſilex, again produced a brown paſte-like precipitate, dily diſſolved in cauſtic lye, leaving a brown flocthis combined with carbonat of ammoniac. Thus it afforded 62 grains of carbonat of lime, which are equal to 34 grains of pure *calcareous earth.*

h) The ſeveral portions of *ſiliceous earth* of (*c*, *d*, and *f*), when ignited and weighed together, amounted to 42½ grains.

It then reſults from this analyſis, that the conſtituent parts of the *veſuvian from Siberia* are preciſely the ſame as thoſe of the Italian. Only ſome variation takes place in their proportions, which, however, is no argument againſt placing them in the mineralogical ſyſtem as *two ſpecies*, or even merely as *varieties* of one *ſpecies.* For an *hundred* parts of the *Siberian* foſſil yielded:

Silex	*h*) . .	42½ grains.	
minus . .	*a*) . .	½	
		42 . .	42
Lime	*g*)		34
Alumine : . .	*f*) . . . . : .		16,25
Oxyd of iron . .	*e*)		5,50
Oxyd of manganeſe	*b*) a trace only.		
			97,75

XXXII.

XXXII.

CHEMICAL EXAMINATION OF *LEUCITE.*

FIRST SECTION.

THOUGH the foſſil at preſent known by the name *Leucite* or *Leucolite*, according to others, often occurs in *Italy*, (where it conſtitutes one of the ingredients not only in the lavas, the crude as well as thoſe that have been converted by volcanic fires into *tufas* and ſlag-ſand, or *volcanic aſhes*, but alſo of other mingled maſſes of rocks) yet there are but very ſcarce and uncertain indications of its exiſtence in other regions *. The *leucite* is remarkable by its very determinate ſpecific figure, which conſiſts of low, double octahedral pyramids, flatly ſharpened off to four terminating ſurfaces; ſo that it forms a roundiſh cryſtal, incloſed in 24 trapeziums.

Still leſs does that leucite ſeem to be known, which occurs in the rocks of Veſuvius, either in maſſes or in an indefinite form, variouſly mingled with black mica, black acicular ſhörl, hornblende, cryſtals of veſuvian, &c. and which hitherto has been moſtly conſidered as glaſſy felſpar, or granular quarz.

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* Of the foſſils foreign to Italy, and taken for leucite, that in particular will moſt probably be confirmed as ſuch on chemical examination, which Dr. *Reuſs*, ſo deſerving in the mineralogical hiſtory of his country, has found in Bohemia, and deſcribed. See his *Mineralogiſche Geographie von Böhmen.* Dreſden, 1797, vol. II. page 311—404.

The former denomination of this foſſil, *white garnet*, *eſuvian garnet*, *garnet-ſhaped ſhörl*, is no longer to be re-ined, ſince the improvements made in *Oryctology*. On the her hand, *Werner* has aſſigned to it a peculiar place in the ineralogical ſyſtem, as a diſtinct ſpecies.

For the following analyſes I have ſelected only ſuch ryſtals of leucite ejected by Veſuvius, as, by their external ppearance and internal luſtre, together with the yet un-hanged ſtate of their ſtony matrix, (which is a black-grey orneous maſs of baſalt), have convinced me, that they had ffered no alteration either by volcanic fire, or by any ſubſe-uent decay. Moſt of them were of the ſize of a nutmeg nd upwards. Before they were employed, they were freed s much as poſſible from the ſtony matrix adhering to their utſide, and likewiſe from the particles of hornblende uſually ontained in their middle. In this purified ſtate their ſpeci-c gravity was 2,455.

A.

Examination in the dry way.

a) The leucite is completely infuſible, if ignited alone pon charcoal. It then undergoes no manner of ſenſible al-eration, and its ſplinters loſe nothing of their luſtre.

b) If a ſmall fragment of it be put into fuſed borax, it is or a long time moved about in it before it diſſolves, which t does by degrees. The glaſs-globule, ariſing from thence, s clear and light-brown

c) By fuſion with a neutral phoſphat, the ſolution is ſtill lower, and a colourleſs rifty glaſs-pearl is produced.

d) One *hundred* grains of coarſely pounded leucite were expoſed for an hour to a ſtrong red-heat, in a ſmall porcelain-pot. The loſs of weight cauſed by this was only one-eighth of a grain.

e) Even the violent heat of the porcelain-furnace produced in the leucite only an inconſiderable change *.

B.

Examination in the humid way.

(1.)

a) *Hundred* grains of leucite, reduced to an impalpable powder, were ſeveral times digeſted in muriatic acid, which diſſolved a conſiderable part. There remained a *ſiliceous* reſidue, of 54 grains, after ignition.

b) This ſiliceous earth was then ignited with twice its weight of cauſtic alkali, ſoftened again with water, covered with muriatic acid, added to exceſs of ſaturation, and, after ſufficient digeſtion with this laſt, collected on the filter, and heated to redneſs. It was found to have ſuſtainod, by this, a trifling decreaſe of weight.

c) On adding pruſſiat of pot-aſh to the muriatic ſolution, a precipitate enſued of ſo ſmall a quantity, as hardly to indicate one-eighth of a grain of *oxyded iron*. As, beſides, this ſlight portion of iron, probably, does not originate from the leucite itſelf, but from ſome particles of hornblende not perfectly ſeparable, I ſhall not conſider it among the conſtituent parts of that mineral.

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* See Eſſay I. No. 55.

d) Upon this I decompoſed the ſolution by cauſtic ammoniac; and, after having ſeparated the precipitate thus obtained, I tried the remaining liquor with carbonated ſoda, but n farther change was effected by it.

e) The precipitate produced by means of pure ammonia (d) was firſt dried. It was next purified by digeſting it wit diſtilled vinegar, and afterwards neutralizing this acid b ammoniac. It weighed 24½ grains, when edulcorated an ignited. Dilute ſulphuric acid completely diſſolved it to limpid liquor, and when properly treated, the ſolution yielde only *alum*.

f) To obtain the earth, which poſſibly might have r mained latent in the ſeveral waſhings, I evaporated theſe t dryneſs. After having re-diſſolved the ſaline maſs in wate I collected the portion of earth which ſtill appeared. Hov ever, it amounted only to half a grain, and was *ſiliceous eart*

Therefore I obtained:

Silex	a)	54	
—	f)	½	
		54½	54,50
Alumine	e)		24,50
			79
Loſs			21
			100

(2.)

This conſiderable loſs, in the ſum of the weights of ſeparated conſtituent parts of the leucite, during this a

ly

lyſis, has induced me to repeat the experiment with ſom variation in the proceſs.

a) One *hundred* grains of leucite were finely ground, an ignited during half an hour, with twice their weight o cauſtic pot-aſh. To the maſs, again ſoftened with water muriatic acid was added, to juſt the quantity neceſſary fo ſaturation. When the mixture had been filtered, I edulcorated and dried the remaining undiſſolved powder of the ſtone.

b) The leucite, thus prepared for decompoſition, was then extracted, in a boiling heat, by means of muriatic acid. There ſeparated ſome *ſiliceous earth*, which weighed 54¾ grains after having ſuſtained a red-heat.

c) The muriatic ſolution was concentrated by evaporation, and tried by oxalat of pot-aſh; but no precipitatio nor turbidneſs enſued. After this I recovered the *aluminou earth* in its pure and ſeparate ſtate, by the ſame means a employed in the preceding experiment. Its weight, afte ignition, likewiſe correſponded, to within a trifle, with tha of the firſt analyſis. It alſo ſhewed, upon farther trial, b re-agents, that, except an unimportant trace of oxyded iron it was not in the leaſt mixed with any other earth, of whatever kind.

d) In the ſame manner, nothing more, of an earthy nature, could be obtained from the edulcorating waters b evaporation.

SECOND SECTION.

This agreement of the reſults of theſe two analytical reſearches increaſed my uncertainty where to look for the cauſe of that loſs of weight. At the ſame time it gave additional ſtrength to the conjecture, long ſince entertained by me, that in the mixture of foſſils, beſides the conſtituent parts, found by analyſis, there might be preſent other component principles, which have hitherto eſcaped diſcovery. That chemical decompoſitions of bodies, even when inſtituted with all poſſible care, are attended by ſome loſs, is founded on the nature of the ſubject itſelf. However, the above loſs was too great to be included in that which is abſolutely unavoidable. It is, indeed, the ſhorteſt way to get over the difficulty, if the loſs in the ſum of the weight of the ingredients, although of ſome importance, is accounted for ſimply by the air and particles of water expelled. But ſuch an explanation would by no means be capable of ſatiſfying me in the preſent caſe.

I was fully convinced, that, in thoſe proceſſes, at leaſt no earthy, or any other component part, ſoluble in water, had been loſt. It was likewiſe evident, from the experiments related in the beginning of this eſſay, that neither *water* nor *carbonic acid* was to be ſought for in leucite. For theſe reaſons, I proceeded to other experiments, which tended to try that foſſil, for the *phoſphoric*, *fluoric*, and *boracic* acids; but of none of theſe I could diſcover any ſign.

On the contrary, I was ſurpriſed in an unexpected manner, by diſcovering in it another conſtituent part, conſiſting of a ſubſtance, the exiſtence of which, certainly, no one perſon would have conjectured within the limits of the mineral kingdom, and, leaſt of all, in the natural mixture of a ſolid foſſil, which, in a *mineralogical ſenſe*, is ſimple or unmixed.

This conſtituent part of leucite, which now appears in the character of an oryctognoſtic or mineral ſubſtance, is no other than *pot-aſh*, which, hitherto, has been thought ex-

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excluſively to belong to the vegetable kingdom, and has, on this account, been called VEGETABLE ALKALI.—This diſcovery, which I think of great importance, cannot fail to occaſion conſiderable changes in the ſyſtems of natural hiſtory, till now eſtabliſhed, and will ſerve to illuſtrate various phenomena in the mineral, as well as in the vegetable kingdom.

The following experiments will ſhew the particulars.

(1.)

a) Two hundred grains of finely triturated leucite were extracted, by repeated digeſtion with muriatic acid. The ſiliceous earth, collected on the filter, and lixiviated, weighed 107 grains after ignition.

b) The muriatic ſolution had a yellowiſh colour. When evaporated in a ſand-heat, to the conſiſtence of honey, I obſerved its ſurface covered with a pretty ſtrong ſaline cruſt. After complete cooling, the maſs appeared like a thick, golden-yellow, clear oil, full of cryſtals, partly of a cubical, partly of a tabular form. I gently poured off the yellow fluid, and rinſed the ſalt with ſmall portions of alkohol. The ſolution, diluted with alkohol, was then evaporated afreſh, and the ſmall quantity of ſalt, which it afforded, again waſhed with ardent ſpirit, and added to the firſt. The ſalt thus obtained, and highly deſiccated, weighed 70 grains. This I diſſolved in water, adding ſome drops of ammoniac, which ſtill ſeparated ſome particles of aluminous earth. The ſolution was then again made to cryſtallize in a warm place, and it afforded only cubical cryſtals, ſome of which were lengthened to quadrilateral columns.

c) That portion of the muriatic ſolution, which would ſhoot into cryſtals, was diluted with water, and decompoſed in a boiling heat by carbonated ſoda. The precipitate conſiſted of aluminous earth, weighing 47¾ grains, when depurated, waſhed, dried, and ignited. Upon this I poured three times its weight of concentrated ſulphuric acid, and evaporated the mixture to a moderate dryneſs. The maſs re-diſſolved in water, then combined with a ſolution of acetated pot-aſh, and ſet to cryſtallize, ſhot entirely into alum.

d) I mixed the ſiliceous earth, obtained at (*a*), with double its weight of pot-aſh, and kept it in a ſtrong red-heat for the length of one hour. The maſs, which had but moderately coaleſced, was ground, diluted with water, ſuperſaturated with muriatic acid, and digeſted. By ſaturation with mineral alkali or ſoda, the filtered muriatic ſolution ſtill afforded 1½ grain of *aluminous earth*; which being ſubtracted from the firſt weight of the *ſiliceous earth* (*a*), there remainded, for this laſt, 107½ grains.

From thoſe decompoſed 200 grains of leucite have, conſequently, been obtained:

Silex :	*d*)		107,50
Alumine	*c*)	47¾	
——	*d*)	1½	
		49¼ . . .	49,25
			156,75

Hence there were ſtill wanting . . . . . 43,25 grs. To account for which, I was to direct my attention to the 70 grains of ſalt mentioned at (*b*).

With a view of diſcovering its baſis, I ſubjected it to the following trials:

Its taſte and the figure of its cryſtals were found to
ciſely the ſame with thoſe of muriated pot-aſh, or
ve ſalt, as it is termed.

No change was effected either in the blue, or in the
ed litmus paper, by its ſolution.

It made a crackling noiſe, when heated to redneſs,
mained behind as a body fixed in the fire.

Its ſolution was not rendered turbid, either by car-
ed ſoda, or by cauſtic ammoniac.

Having poured *two* parts of ſtrong ſulphuric acid
hree of that ſalt, I cauſed the muriatic acid to evapo-
by means of heat, re-diſſolved the maſs in water, and
ed ſulphat of pot-aſh (vitriolated tartar) in its uſual
ls.

The portion of ſalt which yet remained I diſſolved in
e water, and treated it with a concentrated aqueous
on of pure cryſtallized acid of tartar. *Cream of tartar*,
dulous tartarite of pot-aſh, was, by this management,
diately produced, which fell to the bottom in the
of ſand. This was waſhed, dried, and burnt in a

aſſerts, the alkaline baſis of muriated pot-aſh amounts to 61 parts in an hundred of the compound, the above mentioned 70 grains (*a*) contained 42,7 grains of pot-aſh. And thus the 43,25 grains, before wanted to make up the 200 grains of leucite analyſed, are accounted for to within a trifling deficiency.

Conſequently by the reſults of this analyſis, accompliſhed by muriatic acid, *hundred* parts of leucite conſiſt of:

Silex	53,750
Alumine	24,625
Pot-aſh	21,350
	99,725

(2.)

a) *Three hundred* grains of leucite, reduced to a moſt ſubtle powder, were repeatedly digeſted, by boiling with four ounces of nitric acid. The *ſiliceous earth*, when ſeparated by filtration, and ignited, weighed 162½ grains.

b) This nitric ſolution was next evaporated. At firſt it continued colourleſs; but towards the end it turned a little yellowiſh, and after refrigeration it appeared like clear, tenacious turpentine. When diluted with water, and evaporated to but a moderate degree, it congealed into a greaſy ſaline maſs, conſiſting of ſmall priſmatic cryſtals. It was then ſucceſſively treated and waſhed with alkohol, until the ſalt remained in a purified ſtate. To the ſolution of this ſalt in water a few drops of ammoniac were added; to free it from a ſlight portion of earth which ſtill adhered,

and

and which was thus thrown down, and afterwards collected on the filter. After this, the whole of the ſaline ſolution, which was now as limpid as water, by ſlow exhalation has ſhot into priſmatic hexahedral cryſtals, weighing 123 grains, after thorough deſiccation.

c) That portion of the above nitric ſolution, which remained mixed with the ſpirit of wine, and refuſed to cryſtallize, was diluted with water, and, in a boiling ſtate precipitated, by the addition of carbonated ſoda. The earthy ingredient fell down in a ſlimy, ſwelled form.—This, when previouſly waſhed and diſiccated, together with the foregoing ſlight portion of earth (*b*), was treated with diſtilled vinegar, and kept for a while in a warm place. The acetic acid was then neutralized by cauſtic ammoniac; and the earth, precipitated afreſh, collected on the filter, again waſhed, dried, and ignited; in which ſtate it weighed 70¼ grains. It now preſented itſelf in the character of the moſt pure *aluminous earth*; for, when diſſolved by ſulphuric acid, combined with acetite of potaſh, and cryſtallized, it yielded nothing but ſulphat of alumine.

d) Having collected the edulcorating water, I concentrated it by evaporation, and treated it, while boiling, with mild ſoda. But no further precipitation took place.

e) The above mentioned 162½ grains of ſilex were mixed with twice their weight of effloreſced ſoda, and along with it ignited for two hours in a ſilver pot. Upon the maſs, when ſoftened with a little water, an over-proportion of muriatic acid was added, and the whole, after ſome digeſtion, diluted with water, and thrown upon the filter. On ſaturating the muriatic fluid with ſoda, a yellowiſh white precipitate aroſe, which, after heating to rednefs, weighed two grains, and was *alumine*, coloured by iron. As theſe ſhould be ſubtracted, there are only 160½ grains to be put in the account for the *ſiliceous earth.*

It then appears, that in this analytical proceſs, the alkaline-ſaline conſtituent ingredient in the leucite was neutralized with the requiſite quantity of nitric acid, and generated true nitre. But that the above conſtituent part is really and undoubtedly of the very ſame quality and nature with the vegetable alkali, has been evinced by the following examinations.

1.) The taſte and cryſtalline figure of this ſalt perfectly agree with thoſe of common nitre.

2.) When its ſolution had been combined with a ſolution of nitrated ſilver, or with that of acetated barytes, it continued bright and clear. This fact ſhews, that in the natural mixture of leucite, this alkaline-ſaline conſtituent part is contained, not accidentally and merely by the aſſiſtance of carbonic or ſulphuric acid, by which it may be neutralized, but rather in a perfectly pure ſtate.

3.) Upon a part of that ſalt I affuſed half its quantity of ſtrong ſulphuric acid, and carried on its evaporation until the nitric acid had been totally expelled. And when, after this, the reſidue had been re-diſſolved in water, and cryſtallized, it produced ſulphat of pot-aſh in its uſual cryſtalline form.

4.) The portion that remained I introduced into a ſmall porcelain-veſſel, and heated it to fuſion, adding by degrees powdered charcoal in ſmall portions, as long as any detonation took place.—The ſaline maſs remaining conſiſted of *carbonated pot-aſh*: and upon ſaturating it anew with nitric acid, it formed again priſmatic *nitrat of pot-aſh*; in the ſame manner, as *vitrialated tartar* was produced from it by means of ſulphuric-acid, and *digeſtive ſalt* by means of the muriatic.

Concerning the alkaline baſis of nitre, I ſhall take for a ſtandard the proportion ſtated by *Bergmann*, according to which 100 parts of priſmatic nitre contain 49 of vegetable alkali. With this, likewiſe, *Wenzel* very nearly agrees, as he reckons 48⅛ of pot-aſh in 100 of nitre, and this ſmall difference probably depends on this circumſtance, that the latter weighed his nitre in the ignited ſtate. As, therefore, upon this ground of calculation, the above mentioned 123 grains of nitre (*b*) contain 60,27 grains of vegetable alkali, the proportion of the conſtituent parts in 300 grains of decompoſed leucite are as follow:

Silex	c)		160,50
Alumine	c)	70¾	
———	c)	2	
		72¾	72,75
Pot-aſh			60,27
			293,52

Or in *one hundred*:

Silex	53,50
Alumine	24,25
Pot-aſh	20, 9
	97,84

(3.)

I attempted alſo the reſolution of leucite into its prin-iples, by means of *ſulphuric acid.*

a) *Two hundred* grains of finely pulverized leucite were evaporated nearly to dryneſs, in a mixture of 200 grains of concentrated ſulphuric acid with double its quantity of water. From the maſs, again liquefied with water, the *ſiliceous earth* was ſeparated by filtering. It weighed 59 grains, and ſhewed by this, that it ſtill contained ſome grains of undecompoſed leucite.

b) The colourleſs ſolution afforded, by evaporation, a lear, tenacious maſs; which, when again diſſolved in water, preſently ſhot, without any further addition, into egular ſulphat of alumine, weighing 128 grains.

c) This alum I expoſed to a red-heat, and boiled the eſidue, previouſly powdered, with water; ſubtracting at he ſame time the predominant part of the acid, by ſatura-ion with powdered oyſter-ſhells. The filtered and clear olution, being upon this evaporated, ſo as to cryſtallize, ave *ſulphat of pot-aſh.*

d) The remainder of the ſulphuric ſolution (*b*) has ngealed, on farther evaporation, into a greaſy, finely diated maſs.

THIRD SECTION.

In all the preceding experiments the leucite from *Veſuvius* ne was employed. But as leucites are found in various er parts of *Italy*, it was an intereſting point for me to learn, whether, and how far, the conſtituent parts of theſe laſt agree with thoſe of the foregoing.

With this view, I ſelected the leucite of *Albano*, near *Rome*.* The ſpecimens I have obtained of it conſiſt of ſolitary grains, of the ſize of green or ſweet peaſe, and larger. Their exterior colour is a yellowiſh-white, and their cryſtalline figure is for the moſt part indiſtinct, owing to the edges and angles being worn off by friction; whereas the Veſuvian leucite is externally dull, and of an aſh-grey, and commonly occurs with uninjured angles and edges.—The leucite from *Albano*, on the contrary, is clearer, more tranſlucid, and more free from hornblende, in its interior maſs, than that from Mount Veſuvius.

I found its ſpecific gravity to be 2,490.

a) An *hundred* grains of leucite from *Albano*, in a fine pulverulent ſtate, were boiled with muriatic acid, and left behind them undiſſolved *ſiliceous earth*, which, after ignition, amounted to 54 grains.

b) The muriatic ſolution was next evaporated to dryneſs on a ſand-heat, and the yellowiſh-white reſidue, covered with alkohol, was expoſed to a warm temperature, in a high cylindrical glaſs. After it had cooled, I decanted the ſpirituous ſolution of the muriated alumine from the muriat of pot-aſh, which lay at the bottom as a white cryſtalline

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*) I acknowledge my thanks for the communication of this, and a great part of the foregoing leucite to *Count Lepel*, and Dr. *Thompſon*, of Naples. It was by this augmentation of my little ſtock of this foſſil that I was enabled to carry my analytical proceſſes to complete evidence.

powder;

porated in a warm
in ardent ſpirit,
pot-aſh, which ſtill
quantity of it ob-
ding to what has
are *vegetable alkali*,
water, and perfect
of ammoniac, and
perature, it ſeparated
-diſſolved, and com-
ed cream of tartar;
on, afforded *carbonated*

was held in ſolution by
water, and decompoſed
arth, thus precipitated,
when waſhed, dried, and

ucite from *Albano* were

) . . . 54
e) . . . 23
b) . . . 22
99

SECTION.

from the above experiments
queſtioned by thoſe philoſo-
baſaltic matrix of leucite, as
al, as lavas, and hence would
to doubt the primitive ori-
iginality of its alkaline con-
ſtituent

ſtituent part now diſcovered. Therefore, in order at once to obviate every poſſible objection, I reſolved to inveſtigate whether a leucite, the mixture of which muſt be acknowlĕdged as not volcanized, even by the moſt obſtinate Volcaniſts, would contain pot-aſh in its natural mixture as a conſtituent part, though hitherto this alkali has been conſidered as belonging only to the vegetable kingdom. For this purpoſe, I ſelected that *irregularly ſhaped*, finely-grained, foliated *leucite*, mentioned at the beginning of this Eſſay, which either accompanies the ſtony maſſes, compounded of mica, ſhörl, veſuvian, calcareous ſpar, &c. that are ejected by Veſuvius in their original rough ſtate; or which is concreted with them. Of theſe ſpecimens, I ſeparated for this inquiry a ſufficient quantity of *leucite* in a lump or *maſs*, and performed its analyſis according to the method before deſcribed.

By the proceſs I obtained, beſides *ſilex* and *alumine*, a cubically cryſtallized muriated neutral ſalt, whoſe alkaline baſis ſhewed itſelf to be vegetable alkali, from the circumſtance of its producing cream of tartar, by combination with tartareous acid.

This enquiry into the conſtituent parts of that variety of leucite was ſatisfactory; though the determination of their *proportions* could not be accompliſhed with due accuracy, on account of the black needles of ſhörl, ſmall wax-yellow grains of veſuvian, and the like, with which it was too abundantly mixed.

FIFTH SECTION.

(1.)

As the preceding analyſes were all performed with thoſe ſpecies of leucite, which remained in their unaltered origina l ſtate, it remained to complete the ſubject by the exa- tion of a leucite, which had ſuſtained the action of a nic fire.

he ſpecimen of leucite ſubjected to this experiment was ed up at *Pompeji*, and belongs to the moſt common eties. It conſiſts of detached grains, for the moſt part he ſize of a pepper-corn. Its interior ſurface, like the rior, is aſh-grey, of an earthy appearance, and wholly te; and it may be eaſily comminuted to a ſandy der.

Hundred grains of it, decompoſed by muriatic acid, ctly in the ſame manner as the leucite from *Albano* in third ſection, and the muriat of pot-aſh thereby obtain- calculated for its baſis of vegetable alkali, have af- ded:

Silex	54,50
Alumine	23,50
Pot-aſh	19,50
	97,50

It remains for repeated experiments to decide, whether it nerely accidental, that the proportion of the alkaline in- dient, in this inſtance, is leſs than uſual; or whether this inution takes place regularly in every leucite, altered olcanic fire.

(2.)

this place I ſhall, moreover, briefly notice a particular y of leucite, which occurs at *Ronciglione*. It is found

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Thoſe grains
ſtituent part now diſcovered. The they are enti
to obviate every poſſible objectio ſily friable. W
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knowledged as not volcanized, of volcanized leucite,
Volcaniſts, would contain pot ceous earth.—It ſee
as a conſtituent part, though ſuffered any change by
conſidered as belonging on a high degree of de
For this purpoſe, I ſelecte water and air; and finally,
grained, foliated *leucite*, been brought near to
Eſſay, which either acco poſition, or reſolution into
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their vegetation, be required to occupy a more ſuitable place among the original, ſimple mineral ſubſtances, it will then likewiſe be neceſſary to give it a more appropriate name.

The term *Pot-aſh*, which, in the new chemical nomenclature, is raiſed to a *generic* name, cannot among us *Germans* claim a general acceptation; as its origin depends on a trivial *etymological* ground, and has been introduced into uſe merely from this circumſtance, that formerly, inſtead of calcining furnaces, iron *pots* were employed to ignite the inſpiſſated lyes procured from wood-aſhes.

I ſhould wiſh to recommend, that the denominations hitherto uſed, of *vegetable alkali*, *lixiviated vegetable ſalt*, *pot-aſh*, &c. be diſcarded, and the name KALI[*] be employed in their ſtead. In like manner ſhould the appellations, *mineral alkali*, *ſoda*, &c. denoting the alkaline baſis of common ſalt, give place to its ancient name,—NATRON.

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[*] This has been done by the London Royal College of Phyſicians in the year 1787. They have introduced in their *Pharmacopœia* both theſe names, *kali* and *natron*, here recommended by *Klaproth*. The *Edinburgh Diſpenſatory*, on the other hand, calls the firſt *lixiva*, and the ſecond *ſoda*.—However, the terms, *pot-aſh* and *ſoda*, being at preſent more familiar to modern Engliſh chemiſts, the Tranſlator has, for the moſt part, given them the preference.—Tranſl.

XXXIII.

CHEMICAL EXAMINATION OF *PUMICE-STONE.*

THE *Pumice-ſtone* belongs to thoſe mineral bodies, on the origin and formation of which the opinions of philoſophers are yet divided. Various paſſages in the works of *Theophraſtus*, *Dioſcorides*, *Pliny*, and *Galen*, concerning this ſubſtance, ſhew ſufficiently, that, even in remoter ages, Naturaliſts have thought it worth their conſideration. One of the principal foundations abſolutely neceſſary to be laid down by the inquiring *Geogoliſt*, if he wiſhes to raiſe with ſucceſs the edifice of his theories, undoubtedly conſiſts in a juſt and accurate chemical knowledge of his object. This knowledge has, however, been hitherto wanting, with regard to pumice-ſtone. For, although various analyſes of it have been publiſhed, there ſtill occurs a very important difference in the enumerations of its conſtituent parts: ſo much ſo, that the Mineralogiſt is at a loſs to know, which of them he is to follow in the arrangement of foſſils.

Many of thoſe who have analyſed the pumice ſtone, conſider it, with *Bergmann*,* as an *asbeſt* changed in its mixture by a volcanic fire. This opinion ſeemed to be juſtified, partly by its fibrous texture, partly, and eſpecially,

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* *Bergmann* Opuſc. Phyſ. et Chemic. vol. III. p. 197.

by

: portion of magneſia, that has been ſuppoſed to n it. But, notwithſtanding that *Bergmann*, *Car-*[*], and but very lately *Spallanzani*[†], have mentioned gneſian earth, in their analyſes of pumice-ſtone, as a uent part,—I am convinced, by my own experience, does not, in the leaſt, enter into this foſſil. The ſup- prigin of pumice-ſtone from asbeſt is, therefore, un- d; and, along with this falſe derivation, likewiſe, r difficulty of ſome weight is removed, which ſeemed oſe the inſtructive theory of the *matrices of pumice-* iven by *Noſe*[‡].

Common, grey-white, fibrous pumice-ſtone, ſwim- 1 water, and procured from *Lipari*, was ground, iled with water. The water boiled with it was o have extracted nothing; only, by treatment with l ſilver, it gave a ſlight indication of muriatic acid.

dred grains of this pumice-ſtone, gently ignited, and ulverized after decoction, were expoſed to a red- ith twice their weight of cauſtic alkali, during half r. The maſs returned from the fire of a bright een colour; by which it was found to contain a ortion of *mangane͡ſe.* After having been ſoftened ater, this colour changed to a foul light-brown. It n digeſted with dilute muriatic acid. *Siliceous earth* d in this proceſs; which, collected on the filter, and neated to redneſs, weighed 77½ grains.

/hat had been diſſolved by the acid was next pre- l by cauſtic ammoniac, and the browniſh precipi-

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beuſer, Mineralogiſche Abhandlungen, Th. II. p. 136.

llanzani's Travels into both *Sicilies*, vol. II.

raphiſche Briefe, vol. II. page 185 and others. Alſo g *einiger Schriften über Vulkaniſche Gegenstände a. d.* Ba- e 271.

tate collected on the filter. The fluid ſeparated from it, contained no extraneous matter.

c) Hot cauſtic lye directly diſſolved that precipitate, leaving an *oxyd of iron* behind it, the quantity of which, after ignition, was 1¾ grains.

d) The alkaline ſolution, previouſly ſuper-ſaturated with muriatic acid, was combined with carbonated alkali. Thus, the earth which it held diſſolved was precipitated. When edulcorated, and heated to redneſs, it weighed 17½ grains. It proved to be pure *aluminous earth*; for, on being re-diſſolved in ſulphuric acid, and combined with an adequate portion of liquid acetated pot-aſh, it afforded nothing but alum.

In conſequence of this, the conſtituent parts, diſcovered in the common *pumice-ſtone from Lipari*, are:

Silex	*a*) . . .	77,50
Alumine	*d*) . . .	17,50
Oxyd of iron	*c*) . . .	1,75
Beſides a trace of *manganeſe*	*a*)	
		96,75

It is worth remarking the ſmall degree of ſolvent power which acids exert on rough pumice-ſtone. Although I had digeſted 100 grains of finely-ground pumice-ſtone with twelve times its quantity of muriatic acid, aſſiſted by a boiling heat, yet it was hardly attacked. The acid, indeed, was tinged of a faint yellow; however, at moſt, there appeared only a few looſe, browniſh flocculi, which, when moſt carefully collected, ſcarcely amounted to ⅛ of a grain, and conſiſted, for the greateſt part, of oxyd of manganeſe. The ſulphuric acid proved to be as little capable of affecting rough pumice-ſtone as the muriatic.

XXXIV.

CHEMICAL EXAMINATION
OF THE
TERRA AUSTRALIS (Sidney-earth).

A few years ſince, the public has become acquainted with an arenaceous, or ſandy foſſil, under the name *Auſtral-ſand*, which has been found near *Sidney-cove*, in *New South-Wales*, and was brought from thence to England. This foſſil has been aſſerted to contain a new, diſtinct, peculiar earth, denominated *Auſtral-earth (Sidneia, Cambria)*, upon the ground of its analyſis made and publiſhed by *Jos. Wedgwood*[*]; of which the following are the principal particulars. The principal character of that earth is ſaid to be, that it reſiſts all acid and alkaline menſtrua, ſtrong muriatic acid only excepted, which alone, by means of repeated digeſtion, takes up this earth from that arenaceous foſſil. It is alſo ſaid to be again precipitated from its muriatic ſolution, merely by dilution with water; and to be, after this, abſolutely inſoluble in any other ſolvent but the muriatic acid, with the aſſiſtance of heat.

My deſire of acquiring information on this ſubject by my own experience has continued till now unaccompliſhed. It is only of late that I was fortunate enough to receive a quantity of auſtral-ſand; little, indeed, yet ſufficient for an examination ſparingly managed. The ſpecimens obtained were of two ſorts. One of them was mixed with a greater proportion of thoſe black, ſhining lamellæ, that are taken for graphite, but, to my conjecture, are rather flakes, or ſcales, of ferruginous mica. The other ſort was purer, and had leſs of the ſubſtance juſt mentioned. For this reaſon I employed only this in the preſent inquiry.

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[*] *Philoſophical Tranſactions*, vol. lxxx. 1790.

a) I triturated *thirty* grains of it to a moſt impalpable powder. The original grey-whitiſh colour of that foſſil changed thereby to a blueiſh, owing to a more minute diviſion of the particles of ferruginous mica. Strong muriatic acid was then affuſed upon the powder, and digeſted with it for a conſiderable time, in a heat of ebullition. After cooling, the acid was decanted from the ſediment, and this laſt digeſted with a freſh quantity of the ſame acid. This operation was reiterated a third time.

b) When the acid had been filtered clear, through a double-folded printing-paper, I diluted it gradually with a large quantity of water; but not the leaſt turbidneſs nor precipitation enſued. I expoſed the mixture to a warm temperature; yet ſtill it remained clear and limpid, like water.

c) The muriatic liquor was then ſaturated with carbonat of pot-aſh. This threw down a few light particles, which, collected on the filter, waſhed, and dried, weighed 3¼ grains. They alſo diſſolved in dilute ſulphuric acid, but left behind a ſlight portion of ſilex, and formed with that acid cryſtals of alum.

d) The reſidue left on the extraction with muriatic acid was ignited with three parts of carbonated pot-aſh, then again treated with muriatic acid, and its inſoluble ſlimy portion ſeparated by filtration. This laſt conſiſted of ſilex, weighing 19½ grains, when edulcorated and ignited.

e) The muriatic ſolution was then tried with pruſſiated pot-aſh. The blue precipitate hereby produced indicated about $\frac{1}{4}$ grain of iron.

f) By combining afterwards the ſolution with carbonated pot-aſh, aluminous earth was precipitated; which, after ignition, weighed 8$\frac{1}{2}$ grains, and, upon ſolution in ſulphuric acid, entireiy cryſtallized into ſulphat of alumine.

Silex, *alumine*, and a little *iron*, therefore, were all the principles I was able to diſcover in the auſtral-ſand here examined; and no trace of any other conſtituent ingredient appeared.

Although in this inquiry I have been obliged to confine myſelf to the ſmall quantity of 30 grains, without being able to repeat it for want of a greater ſtock of this mineral, yet its reſult is ſufficient to excite a very reaſonable doubt of the *real exiſtence* of ſuch a new earth as is pretended to be met with in auſtral-ſand. Time will ſhew whether this doubt may be removed, or confirmed, by repeated and more accurate analyſes. If the laſt ſhould be the caſe, the illuſion which led to that erroneous ſuppoſition may, perhaps, be explained in the following manner:—

Mr. *Wedgwood* does not tell whether he had filtered, to perfect clearneſs, the muriatic acid employed for the extraction of the foſſil, and *previouſly* to its being mixed with water. The contrary ſeems rather to have taken place; for he ſays that the fluid turned white when he added water to the acid, for the purpoſe of diluting the acid, and edulcorating its remaining part. It is therefore probable that the earth, let fall by the acid on the admixture of water, was nothing elſe but alumine ſtill chemically combined with ſilex, which, during the long and hot digeſtion, had been taken up by the muriatic acid, and was now depoſited in the water.

Finally, that the foſſil here examined was *genuine auſtral-ſand*, is warranted by the hand from which I received it. It was Mr. *Haidinger*, from *Vienna*, who kindly gave it me on his return from London, where he obtained it from the Right Hon. Sir *Joſeph Banks*, Bart.*

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* Since that time *Charles Hatchett*, Eſq. F. R. S. of London, has likewiſe analyſed the *terra auſtralis*, and found it to contain *no new earth*, but to be a compound of ſilex, *alumine, oxyd of iron, and plumbago.* His paper is printed in the *Philoſophical Tranſactions* for the year 1798.—Tranſl.

XXXV.

CHEMICAL EXAMINATION
OF THE
GRANULAR SULPHATED BARYTES,
From Peggau.

THE *granular* baroſelenite, or *ſulphat of barytes*, is one of the rarer ſpecies of this genus of ponderous earth. That of *Peggau*, in *Stiria*, which is the ſubject of this eſſay, occurs of a beautiful milk-white colour, is maſſive, reſplendent, finely-grained, ſemi-indurated, and brittle. It bears a very ſtrong reſemblance to the white, fine-grained Carara-marble; to ſuch a degree, that, by its mere appearance, it might eaſily be miſtaken for it, were it not for its greater ſpecific gravity, which is 4,380, and by which it is readily diſtinguiſhed.

A.

a) It loſes nothing of its weight by ignition.

b) When pulverized, and boiled with a large quantity of water, it imparts to this laſt nothing obſervable by the ſight, taſte, or ſmell. Of all the re-agents, only the ſolution of ſilver in nitric acid rendered the water boiled with it in a ſlight degree opaleſcent.

c) In like manner, nothing of it was diſſolved by digeſtion with muriatic acid. The only exception from this is an unimportant trace of iron, which was detected by Pruſſian alkali.

B.

a) *Two hundred* grains of this foſſil, mixed with 500 grains of carbonated pot-aſh, were ſubjected, for two hours,

XXXVI.

CHEMICAL EXAMINATION
OF THE
TESTACEOUS SULPHAT OF BARYTES,

*From Freiberg**.

IT was, undoubtedly, the powerful attraction which the barytic earth has for ſulphuric acid, exceeding even that of the pure fixed alkalis, that induced the deſerving *Scheele*, who firſt diſcovered it as a diſtinct earth, to think that an alkaline ſalt is incapable of reſolving the natural mixture of baroſelenite into its ſeparate principles. On this account, when attempting to expel its ſulphuric acid, he reſorted to the imperfect and tedious proceſs of repeatedly working the ſtone to a paſte, with honey or oil, of calcining that maſs by means of the muriatic or nitric acids, and, at laſt, of extracting ſuch a part of it as had been diſengaged from the ſulphuric.

Yet there are ſeveral inſtances where the unaſſiſted force of attraction of pure alkali has been too weak to ſeparate the component principles of mixed bodies; while, on the contrary, when they have been employed in the carbonated, or otherwiſe neutralized ſtate, the deſired object has been attained by this new increaſe of attractive force.

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* Chemiſch. Annal. 1796. I. B. S. 387. It is, properly, variety of common *ponderous ſpar. Kirwan* calls it *Baroſelenit* The *author*, with the reſt of the *Germans*, and ſome *French*, calls *(ſchalig)* *teſtaceous*, from its form, pretty equally ſpreading length and breadth, but, comparatively, of inconſiderable thick *Emmerling* has given a maſterly detailed deſcription of its figu varieties. See his *Lehrbuch der Mineralogie*, Gieſſen 1793. page 557. ſeq.—Tranſl.

This is the very caſe with ponderous ſpar, and is founded on the method learnt of *Wiegleb*: which is, to decompoſe it in a ſhorter, cleanlier, and more complete manner, by igniting it with carbonat of pot-aſh. This method, as to the moſt eſſential part, has ſince been univerſally approved and adopted.

It ſeems, however, to be the common opinion, that this decompoſition obtains, in the *dry way* only, and that the ſeparation of ſulphuric acid from barytes abſolutely wants the ſupport of red-heat; as, to my knowledge, no one has yet attempted the *humid way*, to effect it.

A.

a) *A thouſand* grains of *common*, *white*, *thick*, *teſtaceous baroſelenite*[*], in the pureſt ſelected pieces from the mine *Kurprinz Frederick Auguſt*, near *Freiberg* (in Saxony), were triturated with water to the fineſt powder, and then boiled for one hour, in a ſilver pan, with twice their weight of carbonated pot-aſh, and five of water, ſtirring them occaſionally, and ſupplying the loſs of water as it evoporated; which being done, more water was added, and the whole filtered. The reſidue weighed 910 grains, after waſhing and exſiccation. Muriatic acid was affuſed upon it ſucceſſively, until all efferveſcence ceaſed. After gentle di-

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[*] Thick-teſtaceous *(Dickschalig)*, when from ¼ to ½ an inch *thick*.—Tranſl

geſtion,

pot-aſh, calcining the mixture in a ſilver-veſſel during the ſpace of half an hour. After ſoftening the maſs, there remained 50 grains of edulcorated reſidue; which now totally diſſolved in muriatic acid, only five grains of unattacked *ſilex* excepted.

The alkaline lixivium, obtained from that ignited maſs, and ſomewhat reduced by evaporating, then afforded three grains of *ſiliceous earth*.

h) I then evaporated, together, all the muriatic ſolutions mentioned before, to the point of cryſtallization; and they yielded, at the firſt two ſhootings, the muriated barytes in a perfectly pure ſtate.

i) The remaining ſolution ſeemed to exhibit ſigns of the preſence of ſome iron. It was therefore ſaturated with cauſtic ammoniac, and filtered. There collected on the paper a browniſh earth, which, when highly dried, weighed 1½ grain. Yet, notwithſtanding this ſmall quantity, it was not mere oxyd of iron; for, when diſſolved in muriatic acid, and treated by Pruſſian alkali, the fluid remaining, after the ſeparation of the blue precipitate, yielded half a grain of *alumine*, by combination with ammoniac. The portion of iron, therefore, amounted only to one grain.

k) The remainder of the ſolution of muriated barytes, being thus freed from thoſe foreign ingredients, was decompoſed by means of mild ammoniac. I then re-diſſolved the precipitated earth in muriatic acid, and put it in a gentle temperature for farther cryſtallization. Pure muriat of barytes cryſtallized, as long as the ſolution contained one drachm of it; upon which I committed it to ſpontaneous exhalation in the open air. It cryſtallized entirely, without leaving any drop of liquor, to regular cryſtals; of

ich the firſt ſhooting ſtill conſiſted of ſome tables of mu-
ed barytes, but the ſubſequent ones afforded needle-
ped cryſtals of muriated ſtrontian-earth.

) Upon this, I carefully collected the cryſtallized muriat
ſtrontian, diſſolved it again in water, and re-produced it
in in its former ſtate of *ſulphated ſtrontian-earth*, by
pping ſulphuric acid into the ſolution. The ſulphat,
ſhed and dried, weighed 8½ grains.

m) The whole of the cryſtallized muriat of barytes,
ich was collected, amounted to 18 drachms.

n) Another portion of *a thouſand* grains of ſulphated ba-
tes, ground to a moderately fine powder, and ſubjected to
tenſe red-heat for half an hour in a porcelain-crucible,
ſt no more than ſeven grains of their weight; which loſs
ay probably have conſiſted only of the *aqueous particles*
iven out in the proceſs.

It reſults from theſe experiments, that the *white, teſta-*

B.

ult of this analyſis, therefore, demonſtrates, that *way* is likewiſe applicable in the decompoſition of ſpar, by means of alternate boiling with a con-queous ſolution of carbonated pot-aſh, and ſubſe-ion in any ſuitable acid.

anagement affords, eſpecially in operations per-ith great quantities, a double advantage. The ſaving of crucibles, which would be otherwiſe the *ſecond* is this, that the remaining alkali, ght to be recovered after the ſeparation of the med neutral ſulphat, is not liable to be contami-is method.

ponderous ſpar is ignited or fuſed with pot-aſh, that e alkali which is not neutralized, during the pro-e ſulphuric acid of the foſſil, will attack not only us and argillaceous earth, which are uſually con-he ponderous ſpar, but alſo that which enters into nce of the crucible. It will alſo retain a great oſe earths, in a diſſolved ſtate, in proportion as , during ignition, gives out its carbonic acid, and nore or leſs cauſtic. On the contrary, if the pro-iling be employed, no tranſition takes place in the m the mild or carbonated, into the cauſtic or pure ce alſo no contamination of it with ſilex and alu-arife.

XXXVII.

9

XXXVII.

CHEMICAL EXAMINATION
OF THE
CROSS-STONE (*Staurolite.*)

THE chemical analyſis of that foſſil, which is found at *Andreasberg*, on the *Harz*, and has the name of *croſs-ſtone*, *croſs-cryſtal* (*ſtaurolithus*), and conſiſts of double cryſtals, concreted in the form of a croſs, has already been inſtituted by two eminent chemiſts, *Heyer* and *Weſtrumb*. Both have long ago publiſhed their analyſes. It might therefore be deemed needleſs to add mine, if the following reaſons did not excuſe it.

It is well known, that both theſe chemiſts have found *barytes*, beſides *ſilex* and *alumine*, among the conſtituent parts of that foſſil. To ſuppoſe the preſence of barytes, in this inſtance, *Weſtrumb* was ſatisfied with the obſervation, that, by combination with ſulphuric acid, this earth forms a precipitate of difficult ſolution in water. From the ſtate of chemical knowledge of the ſimple earths at that time, it was indeed allowable, to conſider ſuch a precipitate, directly and without trial, as ſulphated barytes.

But ſince we have become acquainted with ſtrontian-earth, which likewiſe combines with ſulphuric acid to a difficultly ſoluble precipitate, that phenomenon alone is not ſufficient to determine, whether a certain earth, met with in any proceſs, be the barytic.

Heyer, on the contrary, when examining the ſtaurolite, found this conſtituent part of it to cryſtallize both in the nitric and muriatic acids; from which he could, with greater confidence, ſuppoſe it to be of a barytic nature. But, as he has given no particular account of the figure of its cryſtals, eſpecially of thoſe formed with the muriatic acid, I thought that a freſh examination of this foſſil might be a means to aſcertain, whether the earth mentioned was really the barytic, or whether the ſtrontian.

a) *One hundred* grains of white cryſtals of the croſs-ſtone, carefully freed by diſtilled vinegar from all adhering calcareous earth, were finely pulverized, and ſubjected to a low red-heat for half an hour, with a double quantity of carbonated pot-aſh. The maſs, which was then eaſy of trituration, was lixiviated with water, and left 109 grains behind.

b) To this reſiduum was added the ſmall portion of earth, which was ſtill obtained from the alkaline lye, by ſaturating it with an acid, and evaporation. I then gently digeſted it with muriatic acid, with which it effervesced, and depoſited *ſiliceous earth*, in a fine, ſandy form, weighing 32 grains, after previous ſeparation by the filter, and ignition.

c) The muriatic ſolution, ſuper-ſaturated with cauſtic ammoniac, gave a tranſparent, paſte-like precipitate, which, upon edulcoration, drying, and ignition, weighed 33 grains. It conſiſted of alumine, but ſtill mixed ſilex. For this reaſon, I combined it with ſulphuric acid, and evaporated it to a moderately dry ſaline maſs, which, again diluted with water, depoſited *ſiliceous earth*, amounting to 17 grains, when heated to redneſs. The true quantity of aluminous earth, therefore, amounted to 16 grains.

XXXVIII.

SOME FARTHER RESEARCHES

CONCERNING

WITHERITE and STRONTIANITE.

FIRST SECTION.

A.

IT is needleſs to prove, that chemical analyſes give more accurate reſults, the greater the quantity is of the ſubſtance ſubjected to decompoſition. But, at the ſame time, it is not leſs evident, that the expence of the proceſs increaſes in the ſame proportion. The chemiſt, therefore, who, beſides time, trouble, and patience, frequently ſacrifices a conſiderable ſum to his love for the ſcience, ſhould not be cenſured for parſimony, if he can but ſeldom perform his analytical experiments with ounces and pounds, but muſt commonly reſtrain himſelf to ſmaller quantities.

The following reſearches on *witherite* may afford an inſtance of what juſt now has been ſaid.

a) *Twelve ounces* of *witherite* from *Anglezark*, (near *Chorley*, in Lancaſhire) coarſely powdered, were gradually diſſolved in *fifty ounces* of a mixture, compoſed of one part of muriatic acid and three of water. Except a few grains of ſand, no reſidue was left. The filtered ſolution, when ſet to cryſtallize, gradually afforded 14 ounces 5½ drachms of *muriated barytes*.

b) The

b) The mother-water, remaining from that ſolution, had acquired a greeniſh colour; and, as likewiſe the cryſtals which laſt formed, ſeemed to tend a little to the green, I deſiccated them in a high heat, waſhed them with alkohol, and added the waſhings to the remaining fluid; which I then treated with cauſtic ammoniac, added to exceſs of ſaturation. By this management, the ſolution was rendered ſky-blue, and, at the ſame time, turbid, by a ſlight portion of earth which then ſeparated. This laſt, collected, and dried in the air, weighed 2½ grains; had a yellowiſh-white colour, and was *aluminous earth, mixed with iron.*

c) On ſuper-ſaturating the filtered fluid with muriatic acid, the blue colour diſappeared. I then treated it with pruſſiat of pot-aſh of the utmoſt purity. This produced a brown-red, tender precipitate, which I carefully gathered, waſhed, and deſiccated. But this, beſides that it was of ſo ſmall a quantity, had ſo firmly adhered to the filtering paper, that it could not be accurately ſeparated from it. It was, therefore, together with the paper, ſubjected to lowred heat, and the aſhes were extracted by liquid carbonat of ammoniac, until the portions of this, ſucceſſively employed, ceaſed to be tinged blue. When upon this, the volatile-alkaline tincture had been evaporated, there remained in the evaporating pan a bright-green, carbonated *oxyd of copper,* weighing half a grain; which diſſolved in a few drops of dilute ſulphuric acid, and immediately precipitated, in the reguline ſtate, on a poliſhed piece of iron, upon which it was dropped.

d) The mother-water of the ſolution of the witherite (*b*), previouſly purified with cauſtic ammoniac and Pruſſian alkali, was next combined with mild alkali prepared from tartar; and the precipitate, that appeared of a dazzling white, being diſſolved in muriatic acid, was left to ſpontaneous ion conſtantly afforded hexahedral cryſtals; precipitated by carbonat of *carbonated-ſtrontian-*

witherite, which are equal to 5760 therefore, of:

barytes	5659 grs.
—— *Strontian-earth*	98
oxyd of copper	0,50
contaminated with iron, and dried in the air	2,50
	5760 grs.

The foregoing analytical proceſs ſerves to confirm the exiſtence of a ſlight trace of copper in the Engliſh witherite, which has been already obſerved by *Weſtrumb* *, as well as the preſence of ſtrontian-earth, both in the Engliſh and Siberian witherite, noticed by *Lowitz* †.

B.

Hitherto, the only places where carbonated barytes is found native, are *Anglezark*, in England, and the *Schlangenberg*, in Siberia; for, the report of its occurrence in the metalliferous mountains of Saxony has not yet been confirmed. However, this foſſil has of late alſo been diſcovered in a third place, which is the pit *Steinbauer*, near

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* *Chemiſche Abhandlungen, von Weſtrumb*, Hanover, 1793, vol. I. page 266.

† *Chemiſche Annalen*, 1795. I. Band. Seite 110.

Neuberg, in Upper-Stiria. It is found there in a ſtratum of ſpatoſe iron-ſtone, partly maſſive, or in conſiderable lumps, and in part coarſely diſſeminated in brown iron-ochre.

One hundred grains of this *Stirian witherite* diſſolved completely, and with efferveſcence, in dilute muriatic acid. The whole of that ſolution ſhot into muriat of barytes, in tabular cryſtals; the aqueous ſolution of which was precipitated in the ſtate of ſulphated barytes, by means of ſulphuric acid.

SECOND SECTION.

A.

The attemps made to free *witherite* from its portion of carbonic acid, ſimply by ignition, and to bring it thus to the perfectly cauſtic ſtate, have hitherto miſcarried, owing to its vitrifying with the maſs of the clay-crucibles; and, on the other hand, its conſuming, and, as it were, diſſolving, thoſe made of charcoal. On this account, I reſolved to repeat the experiment with a veſſel made of platina.

A piece of witherite, weighing 200 grains, was put in a platina crucible, previouſly weighed, and this laſt, when introduced into a ſaggar (*caſſette*) made of clay, was conveyed into the middle chamber, or fire-place, of the porcelain-furnace; where the intenſity of heat is at 136 degrees of *Wedgwood's pyrometer*. When the veſſel had returned from the fire, I found the weight of its contents diminiſhed 23½ grains. The calcined witherite appeared as a dirty-browniſh, coarſe powder; which ſo firmly adhered to the bottom of the crucible, that it could not be detached without injuring the latter. I, therefore, tried whether I could ſoften the calcined witherite with water. But, although

gh the water affuſed upon it became intenſely heated,
ſeparation of the ſtone proved ſo difficult, as to oblige
o aſſiſt it by a boiling heat. The calcined witherite
at the bottom of the platina crucible ſome floſculous
eſſions; and, in general, its internal poliſh ſuffered
n, though the external remained unimpaired.

he loſs of weight, amounting to 11¾ *per cent*, indicated
the witherite had not loſt much above one half of its
onic acid. It was owing to this, that it would not en-
y diſſolve in boiling water, and that the reſidue ſtill
derably efferveſced with acids.

the filtered aqueous and clear ſolution of the calcined
erite, which had been directly preſerved in a well-
ed bottle, I obſerved, after ſome days, that the bary-
arth had cryſtallized in ſeveral ſmall groups, between
h various inſulated cryſtals formed diſtinct octahedrons.
rder to obtain a greater quantity of them, I reduced,
oiling, all the water impregnated with the ignited ba-
to one fourth part; ſeparated by filtration the pelli-
f carbonated barytes, which formed on the ſurface of
fluid during the proceſs; and transferred the liquor,
e yet hot, into a glaſs provided with a ſtopper. Before
water had thoroughly cooled, ſimilar cryſtals were
ed, which I found conſiderably increaſed on the follow-
lay. Thus I ſaw with pleaſure confirmed by my own
riments the fact, that calcined barytes is cryſtallizable
ater; which property *Vauquelin* and *Pelletier* have of
each in a different way, diſcovered at Paris.

B.

nce, therefore, according to this laſt experiment, the
tic earth agrees in this point with the ſtrontian, it fol-

ws, that this property of any calcined earth to cryſtallize
mere water can no longer be conſidered as an excluſive
aracter of ſtrontian-earth. But from this we can by no
eans conclude, that both theſe earths are *identically* the
me. Their eſſential difference, beſides the other diſcri-
inating properties already known, principally depends on
e ſpecifically different degrees of affinity, or chemical at-
action, ſhewn by each of them for the various acids. Of
is, the following experiment furniſhes a proof.

I mixed an aqueous ſolution of acicularly cryſtallized
uriated *ſtrontian-earth* with a ſolution of *acetated barytes*;
aporated the mixture to dryneſs; expoſed the obtained ſa-
e maſs to a ſtrong red-heat in a crucible; re-diſſolved that
ited reſidue in water; promoted the cryſtallization of the
ered ſolution by the uſual means, and obtained only *mu-
ted barytes*, cryſtallized in quadrangular tables.

The muriatic acid, therefore, quitted the ſtrontian-earth,
combined with barytes, with which it had a ſtronger af-

rate examinations. With no better reaſon, has even lately one of the principal French chemiſts* reckoned the precipitation of barytes by Pruſſian alkali among the characters which diſtinguiſh it from ſtrontian earth.—However, this precipitation does not take place, except when the pruſſiated pot-aſh employed is not entirely free from the neutral ſulphat, which uſually contaminates it; for, if the pruſſiat is perfectly pure, it is as little capable of precipitating barytes as any other of the ſimple earths. On this account, whenever I prepare Pruſſian alkali, to be uſed in accurate chemical experiments, I always repeat the proceſſes of its purification, until the ſolution of nitrated barytes is no longer, even in the leaſt degree, rendered turbid by it.

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* Journal des Mines, N. xxi. Prairial, p. 45. ſeq.

XXXIX.

XXXIX.

CHEMICAL EXAMINATION

OF THE

SULPHATED STRONTIANITE

*from Penſylvania**.

AFTER the ſtrontian-earth had been eſtabliſhed as a peculiar, chemically-ſimple earth, it was to be expected, that it might likewiſe occur combined with *ſulphuric acid*, inſtead of the *carbonic*, as is the *ſtrontianite* from Scotland. This conjecture was already in part verified; as it has been found, that moſt of the ponderous ſpars contain ſulphated ſtrontian-earth in their mixture, though in only a ſmall proportion, not amounting in the baroſelenites, hitherto examined with this view, to more than from one to two *per cent.*

But the preſent analyſis will fully prove the exiſtence of a perfect *natural ſulphat of ſtrontian-earth*, without any portion of barytic ingredient.

The foſſil, in which I diſcovered this combination, has been known but a few years. It was at firſt called, *blue, fibrous gypſum, from Frankstown*, in *Penſylvania.* The following are its diſtinctive characters.

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* Sulphat of ſtrontian-earth (*ſtrontites*) has alſo been diſcovered lately in the beach at *Auſt-paſſage*, near *Briſtol*, in Glouceſterſhire, in ſeveral veins. This foſſil has been analyſed by *William Clayfield*. See *Contributions to Phyſical and Medical Knowledge*, &c. collected by Dr. *Beddoes*.—Tranſl.

ts colour is a pale ſky-blue. It occurs in flat layers, or ta, from $\frac{1}{4}$, $\frac{1}{2}$, to $\frac{5}{8}$ of an inch thick, included between even ſides; which laſt partly appear to be real ſeams, joints (*ſaalbänder*), and, partly, are mere ſeparating aces, formed by ſmall clefts of the rock, filled with r. On theſe exterior ſides the foſſil has a dull appeare; but, internally, it is poſſeſſed of the ordinary luſtre. s eaſily comminuted, and conſiſts throughout of coarſe, llel, brittle fibres, which form needle-ſhaped fragments.

The ſpecific gravity of this foſſil I found to be 3,830. is conſiderable weight naturally ſuggeſted a doubt of belonging to the ſpecies of gypſum. For this reaſon, it been conſidered as a variety of ponderous ſpar, and ced in the mineralogical ſyſtem in the character of *fibrous hat of barytes*. This, however, is not more its proper e, than that of gypſum, or ſulphat of lime.

A

Hundred grains of the foſſil, finely pulverized, were l in one pound of diſtilled water; whereby it loſt grains. The water of the decoction was rendered by mild alkalis, by oxalat of pot-aſh, by the nifolution of ſilver; but, moſt of all, by muriated .

he powder, when again dried, was treated with acid; which, a trace of iron excepted, extracted that was obſervable.

B.

gnited *two hundred* grains of ſuch pieces of the vere pure, and free from the grey argillaceous matter, [illegible] fiſſures. It loſt by this about one [illegible] colour paſſed into the light [illegible] triturated, then mixed with [illegible] pot-aſh, and the mixture expoſed [illegible] moderate red-heat, during the ſpace of [illegible] became grey, ſtrongly coaleſced, [illegible] fuſion. Upon this, I pulverized it, [illegible] collected the earth upon the filter.

[illegible] was ſuper-ſaturated with muria- [illegible] dryneſs, and the ſaline maſs ſoft- [illegible] and neutralized with alkali. As by [illegible] ſeparation of earth was obſervable, I ſa- [illegible] to exceſs with muriatic acid, and [illegible] muriated barytes. In this way I obtained [illegible] *ſulphat*, which, upon ignition, weighed

[illegible] which remained after the decoction of the [illegible] had been fuſed with the alkali (*a*), was [illegible] muriatic acid, which readily attacked, [illegible] entirely, with efferveſcence. Cauſtic am- [illegible] the colourleſs ſolution, clarified by filter- [illegible] the ſmall portion of iron which it con- [illegible] perceptible browniſh flocculi. The ſolu- [illegible] freed from iron, I precipitated its earthy [illegible] carbonated ammoniac, aſſiſted by heat.

[illegible] earth hereby obtained was very white, tender, [illegible] gravity, and weighed 164 grains in its dry [illegible] It was again diſſolved in muriatic acid, and the ſo- [illegible] to cryſtallize by gentle evaporation. It gradu- [illegible] entirely, ſhot into long needled cryſtals of ſix une- [illegible] which middle, or earthy ſalt, proved, upon [illegible] to be mere *muriat of ſtrontian-earth*. A little of this

ſalt,

t, brought into contact with the wick of a burning can-
:, gave to the outer flame a highly beautiful carmine-red;
d a ſolution of it in moderately ſtrong ſpirit of wine
rned with the ſame colour, when cotton, or printing pa-
r, dipped into it, was ſet on fire.

Hence it appears, from this analyſis, that the above foſſil,
ith the exception of its trifling portion of iron, conſiſts
lely of *ſulphated ſtrontian-earth.*

C.

I repeated this analyſis in a ſhorter way: by boiling
ith alkaline lye, without previous ignition.

a) *One hundred* grains of the foſſil, ground to a moſt
btle powder, were mixed with a triple quantity of carbo-
ated pot-aſh, covered with ſix ounces of water, made to
il, and kept in that ſtate during half an hour.

b) The lixivium, filtered off from the remaining earth,
as ſaturated to exceſs with muriatic acid, in which ſtate it
ntinued clear; and was then combined with ſucceſſive
rtions of muriated barytes, till no more precipitate en-
ed. The *ſulphat of barytes*, thus produced, weighed 126
ains after waſhing and drying, and 124 after ignition.

c) The earthy part of the foſſil, which had been diſen-
ged from the ſulphuric acid by boiling with alkali, and
d in its ſtead taken up carbonic acid, weighed 82 grains.
uriatic acid diſſolved it entirely, and with rapidity, leav-
; only a few brown particles behind. The filtered ſolu-
n was firſt treated with an over-proportion of cauſtic
nmoniac, and, when no longer rendered turbid by it, was
cipitated by mild, or carbonated pot-aſh.——It gave
again

again its former weight of *carbonated ſtrontian-earth*; namely, 82 grains, when dried in the air. When heated to redneſs, it formed a moderately conglutinated maſs, and occupied only one half of its former volume; yet it did not loſe an entire grain in weight. After trituration, though previouſly ignited, it diſſolved rapidly, and with efferveſcence, in muriatic acid; and gave, by this combination, *muriated ſtrontian-earth*, in long, thin columns, of ſix unequal lateral ſurfaces.

Hence, the reſult of this decompoſition in the *humid way*, accompliſhed ſo completely, and with ſo much eaſe, moſt exactly correſponded with that of the preceding.

Now, ſince previous experiments have ſhewn, that 126 parts of *barytic ſulphat* contain 42 of *real ſulphuric acid*, or *without water*; and ſince 82 parts of carbonated ſtrontian-earth contain 58 of *pure ſtrontian-earth*, the proportion of the ingredients conſtituting the Penſylvanian, blue, fibrous, *ſulphated ſtrontianite* is accordingly:

Strontian-earth	58
Real *ſulphuric acid*	42
Oxyded iron, a ſlight trace	
	100

By theſe analytical experiments it is fully proved, that I was not miſtaken, when I ſuſpected this foſſil to be a ſulphat of ſtrontian-earth. In forming that conjecture, I was chiefly determined by its ſpecific gravity, which is conſiderably leſs than that of ponderous ſpar; and, likewiſe, by its fibrous texture: for, even the artificial combination of ſtrontian-earth with ſulphuric acid, effected by diſſolving that earth in this acid, cryſtallizes into needles, reſembling the fibres of the foſſil, though ſmaller and more delicate.

XL.

XL.

CHEMICAL EXAMINATION
OF THE
ATER OF THE BOILING SPRING,
at RYKUM, *in Iceland**.

NSIDERING the ſlowneſs, with which the knowledge
: chemical properties of even the moſt common natural
s uſually advances, it is not ſurprizing, that even thoſe
ceous earth have ſo long remained but partially inveſti-
. This earth has always been conſidered as a ſub-
e, by itſelf, abſolutely inſoluble in water. It was,
fore, totally neglected in *hydrologico-chemical* inquiries,
ſearches into mineral waters, until *Bergmann* directed
ttention of chemiſts to its ſolubility in ſimple wa-
and demonſtrated that it exiſts in a ſtate of ſolution in
Geyſer, and other boiling ſprings of Iceland.

t although, in this inſtance, this celebrated philoſo-
juſtly conſiders the heat, which the water of thoſe
gs poſſeſſes when it riſes into day, (and which even then
her than that of ordinary boiling), as a means of pro-
ng the ſolution, yet experience has ſhewn, that an ac-
ſolution of ſilex in water takes place, not only in
gs, the natural temperature of which is much inferior
e ebullient heat of thoſe in Iceland, but alſo in ſeveral
mineral waters: and even that ſome common ſweet-
r ſprings contain diſſolved ſiliceous earth.

hus, when I was attentive to this point, whilſt ana-
g the mineral waters of *Carlsbad**, I found that 1000
: inches of the main ſpring contain 25 grains of *ſilex*,
lly diſſolved.

Read in the *Royal Academy of Sciences at Berlin*, Auguſt 28, That this is not the greateſt quantity of ſiliceous earth ſoluble in water, and that, eſpecially, the hot ſprings in Iceland might poſſily contain a much larger proportion of it, I was led to conjecture from the *ſiliceous tufas* which they depoſit in conſiderable quantities. At that time, however, a proof of this opinion, ſupported by chemical inveſtigation, was ſtill wanting. It gave me, therefore, the greateſt pleaſure, when I received a ſufficient quantity of water of one of the principal Icelandic ſprings, which enabled me to perform this inquiry, and to compare its reſult with that of the analyſis of Carlsbad water.

In modern times, *Uno von Troil*, and after him, *Banks* and *Solander*, have particularly deſerved well of the Natural Hiſtory of Iceland, ſo remarkable in ſeveral of its individual ſubjects, ſome of which are *unique* in their kind. The lateſt voyage to that iſland, undertaken for the purpoſes of Natural Hiſtory, is that of *Stanley*, in the year 1789. This learned traveller, (who has given in the papers of the Royal Society of *Edinburgh* a circumſtantial deſcription of the ſpring at the Geyſer), when collecting the natural products of that ſpot, had likewiſe providently brought back with him a number of bottles filled with the water of thoſe ebullient ſprings.—Two of theſe, that came to my hands, ſerved for the following analyſis.

The water contained in both bottles is from the ſpring at *Rykum*. From this ſpring, 24 Engliſh miles diſtant from *Hafnifiord*, the water ruſhed formerly out to the height of 60 or 70 feet. But ſince the orifice of the ſpring has been covered, for the greateſt part, by an overthrow of the rocks, the ſtream of water, at preſent, ſpouts off ſideways, from 50 to 60 feet. The heat of this ſpring, even after the jet, is ſtill ſo intenſe, that Fahrenheit's thermometer riſes to 212°. Therefore, as it is beyond a doubt, that part of the heat is loſt during the ſpouting, and, conſequently, that the water muſt have been ſome degrees hotter in its ſubterraneous reſervoirs; Nature affords us here an inſtance, in the large way, of what Art performs in the ſmall, by Papin's digeſter: namely, that confined water, even while in its unelaſtic, denſe, liquid ſtate, is capable of acquiring a degree of heat, ſurpaſſing that of its boiling point.

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* See p. 274 of this work.

The water, in both bottles, was clear, bright, without ſediment, and without taſte. Yet, at the ſpring itſelf, it ſhewed ſome ſulphureous ingredient, according to *Stanley*. For, when employed freſh from the ſpring, it gave to the infuſion of tea prepared with it, as well as to the meat boiled in it, a nauſeous taſte; whereas, the water from the ſpring at the Geyſer, uſed in the ſame manner, gave no ſign of it. But as, in the water which I examined, I could not diſcover any ſulphur, either by the taſte, by the ſmell, or by re-agents, it remains undecided: whether this effect proceeded from a portion of highly volatile, ſulphurated, hydrogen gas, only obſervable at the ſpring itſelf, or whether, perhaps, the ſmell produced by putreſcent, organic ſubſtances has not been miſtaken for it; which laſt is not ſeldom the caſe, with various waters, ſuppoſed to be hepatic.

On employing other re-agents, it appeared, that this water from *Rykum* contains neither free carbonic acid, nor iron, nor lime, nor magneſia; and that *carbonated*, *muriated*, and *ſulphated ſoda*, are to be expected.

Guided by theſe previous indications of the conſtituent parts of this water, I performed its analyſis in the following manner.

I evaporated

Carbonated free ſoda . . .	1,50 grains
Silex	10,80
Muriat of ſoda	8,40
Dry *ſulphat of ſoda* . . .	3,70
	24,40

When the numerous, and partly unavoidable cau conſidered, which occaſion ſmall differences in the pro of the conſtituent parts diſcovered, theſe two analyſes conſidered, upon the whole, as reciprocally confirmin other. The quantity of *alumine*, which, being ver ling, I have not determined, ſhould, according to Dr. analyſis, be eſtimated at $\frac{1}{7}$ of a grain in 100 cubic in water.

What in particular has attracted the attention *Black* is the *ſiliceous earth* he diſcovered, and its ſ in water. For this reaſon he ſays, that in the co that inquiry he had detected in ſilex ſuch properties a never before been ſuſpected in it, or never been acc deſcribed. He here principally alludes to the fac ſiliceous earth diſſolved by fixed alkalis will not ſ from them, even when neutralized by alkalis, as l a ſufficient quantity of water required to that ef preſent *.

Dr. *Black* aſks; " How and by what means is th
" ceous earth diſſolved in water?—Is the hot water,
" own accord, poſſeſſed of the power of diſſolvin

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* Without inculpating the ingenious Dr. *Black* for th deficiency in his acquaintance with the experiments made German Chemiſts, I cannot avoid remarking, that I have earlier period, known and deſcribed that property of ſi earth. See my *Chemiſche Unterſuchung des Elaſtiſchen Ste Braſilien*, im. 6. B. der *Schrift. d. Berl. Geſellſchaft Natu Freunde*, 1785.

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“ earth ; or can this be effected only by the means of the “ intervening alkali ?”—In anſwering theſe queſtions, he does not approve of *Bergmann's* opinion, that the ſolvent power of water, aſſiſted by heat, is alone ſufficient for this effect. He rather thinks, that the alkali is the efficient cauſe of this ſolution, and the heat merely a means of promoting it. In his opinion, a chemical combination of the ſilex with alkali is always preſent, when water exerts a diſſolving power on the earth, and this idea he ſupports by the example of the agency of hot aqueous vapours upon glaſs. The doubt, which might be raiſed againſt it, from the diſproportion of theſe two ſubſtances to each other in the Iceandic hot ſprings, he wiſhes to obviate by ſtating, that the ſilex had originally been united in them with a much larger portion of alkali; but that, ſubſequently to the ſolution of this compound in water, part of the alkali had again been neutralized by acids, or acid vapours, that combined with the fluid. But there is no neceſſity for this mode of explanation; as it is manifeſt by ſeveral facts, that ſiliceous earth alone, if under favourable circumſtances, is ſoluble in water, without the concomitant aid of alkaline ſalt.

Moreover, this opinion, that the ſilex exiſts in the above mentioned ſprings in a ſtate of chemical ſolution by ſoda, ſeems likewiſe to have led Dr. *Black* to preſuppoſe this alkali in thoſe waters in the *cauſtic* or *pure ſtate*, that is, *free from carbonic acid*; becauſe it is allowed on all hands, that, in this ſtate only, is it capble of effecting this ſolution. Yet, not to mention that no proof is given of this hyphotheſis, there occurs no inſtance in nature, upon which to eſtabliſh its probability. The very efferveſcence, that enſued on ſaturating with acetic acid the ſaline reſidue left by the evaporated water, would prove the contrary; unleſs, indeed, it be objected to this argument, that the alkali had attracted the carbonic acid, during the evaporation of the water.

XLI.

CHEMICAL EXAMINATION

OF THE

SILICEOUS TUFA, (Kieſeltuff.)

From the Geyſer.

IN the ſame manner, as mineral waters impregnated with lime depoſit the *calcareous* tufa in various forms, do the hot ſprings in Iceland depoſit their *ſiliceous* ingredient in the form of tufa. It is likewiſe of this *ſiliceous* tufa that the wonderful pipe and baſon conſiſt, which the *Geyſer*, the largeſt of the ſprings in Iceland, has formed for itſelf. *Von Troil* found, in the year 1772, the circular orifice of that pipe, whoſe depth is unknown, and which the ignorant Icelander conſiders as the gate of hell, to be 19 feet in diameter. On the upper part, the aperture widens in the form of a large baſon of 60 feet in diameter, and whoſe exterior border is 9 feet higher than the pipe itſelf. From this pipe the water ſpouts out ſeveral times in the day, by guſhes, at unequal intervals of time, with powerful force, and ſometimes to the height of above 100 feet. What a grand ſight muſt it afford, to ſee a column of boiling water, 19 feet in diameter, ruſh up to ſuch a height! To form an idea of that column of water, let it be compared with the moſt celebrated artificial fountains, for example, that on the *Carlsberg* near *Caſſel* in *Heſſia*, which is only 14 inches in diameter, and hence is more than 16 times ſmaller than the Geyſer.

As the ſiliceous tufa produced by this ſpring is to be met with only in few collections; and as,—beſides the ſhort account given by *Bergmann*, in his treatiſe *De Productis Volcanicis*,—no other characteriſtic deſcription of it exiſts, I here inſert that, which *Karſten* has drawn from the ſpecimens in my poſſeſſion.

SILICEOUS TUFA.

" Its *colour* is partly *reddiſh-white*, and externally ſpeckled with *cochineal-red*; partly *greyiſh-white*, with yellowiſh-grey ſtripes.

" It occurs in *maſſive* lumps, and alſo *denticulated*, *corroded*, and moſt finely *botryoidal*.

" Its exterior ſurface *perfectly-dull*.

" But internally partly *dull*, in part highly *glittering*, and then of a *ſilky luſtre*; here and there a little *reſplendent*.

" Its fracture partly *compact*, and totally *flat conchoidal*, or *uneven*; partly *fibrous*.

" It breaks into indeterminate angular, not very ſharp fragments.

" It conſiſts, when conchoidal, of *finely grained* inſulated pieces; when of uneven fracture, it then is found in ſeparate *thin* and *curved teſtaceous* pieces; and its fibrous varieties preſent no detached pieces.

" It is alſo, more or leſs, *ſtrongly tranſparent on the edges*.

"5. *Semi-indurated*; may be ſplit in pieces without any great difficulty; is very *brittle*, and of little *weight*."

Note. The *fibrous* variety has always the luſtre of ſilk, and the fibres croſs each other in ſuch a manner, that its inſide has a *cellular* appearance.

For the following analyſis of the *ſiliceous tufa from Iceland*, I have choſen the *fibrous* variety, whoſe ſpecific gravity is = 1,807.

One hundred grains of it were finely triturated, and ignited for two hours, in a ſilver crucible, with four times its weight of mild pot-aſh. When the concreted maſs had cooled, I poured water upon it, ſaturated it to exceſs with muriatic acid, and filtered it after ſome digeſtion; upon which the *ſiliceous earth* remained behind in its uſual ſlimy form.

The acid fluid, being afterwards ſaturated with mild, or carbonated pot-aſh, was rendered turbid by it; and depoſited a ſlight looſe precipitate; which, collected, waſhed, and deſiccated, weighed 3 grains; but when re-diſſolved afreſh in muriatic acid, it ſtill left 1 grain of *ſilex*.

The ſolution ſtill contained 2 grains of diſſolved matter: namely, ½ grain of *oxyded iron*, and 1½ grain of *aluminous earth*. Theſe, likewiſe, were ſeparated.

Hence the ingredients, found in the above 100 grains of analyſed *fibrous ſiliceous tufa*, from the *Geyſer*, conſiſted of:

Silex	98
Alumine	1,50
Oxyd of iron . . .	0,50
	100

XLII.

CHEMICAL EXAMINATION

OF THE

ELASTIC QUARZ[*],

(Sand-ſhiefer, flexible Sand-ſtone)

From Braſil.

THE ſingular elaſtic flexibility ſo ſeldom occurring in the mineral kingdom, in which this foſſil, in its form and appearance, reſembles novaculite (Turkey-hone), has attracted the attention of Naturaliſts, but at the ſame time has led many perſons to doubt its exiſtence as a natural ſubſtance, and to ſuſpect, that this may probably be a product of art. It comes from Braſil, near *Villa-rica*, the principal town of the province of *Minas Geraës*, which fact was, for a while, kept a ſecret. There it occurs in not very thick ſtrata, whoſe *hanging* and *ſhading ſides* are caſed over by a grey cruſt of ¼ inch thick; and from thence it was brought

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[*] Schriften der Berliner Geſellschaft Naturforſchender Freunde. 6. B. 1785, pag. 322.—The miners indicate by theſe expreſſions the greater or leſs ſlope in the ſtrata, though chiefly with reference to *rake-veins*, not fully perpendicular. The hanging ſide is that towards the day, and is alſo called *hanger*; and the hading ſide, which likewiſe goes by the name *ledger*, is the under one next to the bed of the ſtratum. See *Williams's Natural Hiſtory of the Mineral Kingdom*, 8vo. Edinb. 1789. vol. I. page 269.—Tranſl.

It weighed one grain; of which, however, only ½ grain can be reckoned as *oxyd of* iron, entering into the 100 grains of the decompoſed foſſil.

e) At laſt, by ſaturating the ſolution with carbonated potaſh, a tender earth was thrown down; which, after waſhing, drying, and ignition, weighed 2½ grains; and, examined by means of ſulphuric acid, was found to be *aluminous earth*.

Conſequently, *hundred* parts of *elaſtic quarz* from *Braſil* have yielded:

Silex	96,50
Alumine	2,50
Oxyd of iron . . .	0,50
	99,50

There are ſometimes very ſmall blackiſh grains, like points, mingled with this ſtone. As theſe probably are garnets, or cryſtals of horn-blende, it ſeems that the portion of iron and alumine diſcovered in the foſſil chiefly proceeds from them.

XLIII.

CHEMICAL EXAMINATION

OF THE

GLASS-STONE (Hyalite),

From Dauphiny[*].

As the term *Shörl* was formerly uſed in too vague a ſenſe; to remedy this uncertainty, it has been found neceſſary to confine its mineralogical ſignification within narrower limits. On this conſideration, the foſſil here treated of, which *Romé de l'Iſle* has firſt introduced into public notice, by the name, *Schörl tranſparent*, *lenticulaire*, but which has ſince become more known by that of *Violet-Schörl*, could no longer be ranked under that head. *Werner*, therefore, has claſſed it as a diſtinct ſpecies, and given it the name, *Thumerſtone*. But it alſo has got other names, ſuch as, *Glaſs-ſtone*, or *Haylite*, *Pſeudo-ſhörl*, *Glaſs-ſhörl*, *Oiſannite*.

It was, for the firſt time, diſcovered in *Dauphiny*, chiefly at *Bourg d' Oiſans* near *Allemont*; partly upon a blackiſh-grey horn-blende-ſlate, partly in the clefts of a greeniſh-grey gneiſs, already ſomewhat ſoftened by decay, where it is accompanied by quarz, amianth, and cryſtallized actinolite. Moſt of its cryſtals are upright, and their leading figure is very compreſſed rhomboidal parallelopipedons or

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[*] See Magazin für Die Naturkunde Helvetiens. I. B. 1787 pag. 180.

i) In order to decompoſe the ſelenite, I boiled it during quarter of an hour with a ſolution of carbonated pot-aſh, ſuch a proportion as made the alkali predominate. T earth left behind weighed 26½ grains, after waſhing a torrefaction; and proved, upon trial, to be a highly pu carbonat of lime. Therefore, ſince nine parts of crud calcareous earth afford by ignition five parts of burnt o quick-lime, the above-mentioned 26½ grains are equal to 14 grains of *calcareous earth*, freed from water and carbonic acid.

k) Thoſe 41½ grains of earth (*g*), together with the 2½ grains (*h*), which I took for *alumine*, were combined with three drachms of concentrated ſulphuric acid; and then diluted with ſome water. The mixture exhibited a pleaſing roſe-colour; but which, on inſpiſſating the fluid almoſt to dryneſs, paſſed into a light blue: ſhewing thus the preſence of a ſmall trace of *manganeſe*. On being re-diſſolved in water, it yet depoſited ſome *ſiliceous earth*, weighing 3¾ grains, after ignition. By ſubtracting theſe from the foregoing 44 grains, that were held in ſolution by the ſulphuric acid here employed, the quantity of *aluminous earth* found in the foſſil is reduced to 40¼ grains.

l) To be aſſured that this ingredient is pure alumine, unaccompanied by magneſia, I heated the ſolution to the degree of boiling, and gradually ſaturated it with elutriated chalk, until it effervesced no more, and no acid could be obſerved to predominate. After gentle boiling for half an hour, I filtered the fluid, reduced its quantity by evaporation, and ſeparated the ſelenite which yet appeared. However, no ſign of ſulphated magneſia could be perceived in the ſolution, either by the taſte or by re-agents.

Thu

Thus the decompoſed 157 grains of *hyalite*, from Dauph- y, have yielded:

Silex	c)	79	82,75
——	k)	3¼	
Alumine	k)		40,25
Lime	i)		14,75
Oxyd of iron, including that of *manganeſe*	d)		15
			152,75
Loſs			4,25
			157

Wherefore, an hundred parts contain:

Silex	52,7
Alumine	25,6
Lime	9,4
Oxyd of iron and *manganeſe*	9,6
	97,3

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[illegible] XLIV.

[illegible] EXAMINATION

OF

[illegible] OPRASE,

[illegible] ltant Green Earth *.

[illegible] a natural product, hitherto exclu- [illegible] found near the village *Koſemütz*, in [illegible] *Glaſerberg*; where it occurs in the [illegible] of a ſoft ſerpentine rock, together [illegible] chalcedony, opal, aſbeſt, talc, [illegible] other ſpecies of earths †.

[illegible] agreed in ſtating the conſtituent parts of [illegible] opinions chiefly differ with reſpect to [illegible] the green colour of this ſtone:

hereby changed to a blueiſh-grey; and, by a ſecond torrefaction and quenching, into a blueiſh-white. The ſtone loſt 1½ *per cent.* by the ignition, and became ſo ſoft, that it admitted of being eaſily ground to a very ſubtle powder.

Three hundred grains of this powder, mixed with twice their weight of dry carbonated ſoda, were ſubjected to a low red-heat for ſome hours, in a veſſel made of porcelain-clay. The maſs was then powdered while yet warm, and digeſted with water. The ſolution acquired a dirty browniſh colour, and left, upon filtration, a grey-yellow reſidue of 44 grains when edulcorated and dried. It paſſed colourleſs through the filter, and by ſaturation with muriatic acid, it yielded a copious precipitate; which, collected, waſhed, dried, and ignited, conſiſted of 268¼ grains of *ſiliceous earth.*

b) Upon the 44 grains of reſidue, that were ſeparated on diſſolving the ignited maſs in water (*a*), introduced into a retort, I poured *eight* times their weight of nitro-muriatic acid, and digeſted them together. This done, I abſtracted the greateſt part of the acid, and what had diſtilled over I returned upon the contents of the retort; digeſted it once more, and then filtered the whole. There remained on the paper a white, looſe *ſiliceous earth*, weighing 20¼ grains upon ignition.

c) To the filtered ſolution I added cauſtic ammoniac in exceſs. Its colour, which before was of a dilute green, turned blueiſh; and a little browniſh matter fell down in the form of ſlime. Upon this precipitate nitric acid was affuſed in a ſmall retort, and again diſtilled off from it. This affuſion and abſtraction were repeated twice more; and, at laſt, the retort was ſtrongly heated to redneſs upon charcoal. The reſidue I then diſſolved in weakened nitric acid. A brown *oxyd of iron* remained, amounting to ¼ grain, which, diſſolved in muriatic acid, afforded, with Pruſſian alkali, a deep blue; and, with tincture of galls, an ink-black precipitate. Whence this portion of iron, as it is ſo ſmall, can have no ſhare in producing the green colour of chryſopraſe.

From the nitric ſolution, cleared from iron, carbonated ammoniac precipitated ½ grain of looſe *aluminous earth*, weighed in the dry ſtate; but for which, in the ignited ſtate, only ¼ grain can be reckoned.

No trace appeared of *magneſian earth.*

d) The ſolution, ſuper-ſatuated with cauſtic ammoniac (*c*), was tried for lime; and with this view combined with carbonated ſoda. The precipitate produced was carbonat of lime. Upon deſiccation, it weighed 4¼ grains, which denote 2½ grains of *calcareous earth*, in the ignited ſtate.

e) The fluid, from which this lime had been ſeparated, ſtill preſerved its blueiſh colour (*c*), and yielded no precipitate, either with acids or with alkalis. For this reaſon, it was diſtilled to dryneſs. There remained in the retort a yellowiſh ſaline maſs, which again made a green ſolution with water. When this ſolution had been combined with mild pot-aſh, it depoſited only a ſlight portion of a white-greeniſh earth; the remainder would not precipitate, notwithſtanding all my endeavours: therefore, I dropped into the mixture as much nitric acid as was neceſſary to re-diſſolve the precipitate, and treated it with pruſſiat of pot-aſh, until the whole was ſeparated. The collected, waſhed, and dried precipitate had a ſea-green colour, and weighed 17 grains.

f) In this precipitate, therefore, that conſtituent part of chryſopraſe was contained, on which its green colour de-hat then is the constituent part? Certainly not this, by its nature, will never diſſolve in cauſtic ammoniac, nor ever produce with it a blue colour. Beſides, it would have been precipitated of a deep blue, by the Pruſſian alkali, with which it was tried (*c*); and, laſtly, the oxyd of iron, of which there exiſts only a very ſlight portion in the chryſopraſe, had already before been ſeparated ( ). Neither can it be ſaid, that *copper* forms any part of that precipitate. This metal does indeed diſſolve of a blue colour, in ammoniac, as does the above-mentioned precipitate; but as this property does not excluſively belong to copper alone, no deciſive concluſion can be deduced merely from this circumſtance. Moreover, the bright aqua-marine colour of this precipitate, produced by means of pruſſiated pot-aſh, has abſolutely nothing in common with the red-brown colour, with which copper always preſents itſelf, when thrown down from any ſolvent by that precipitant.

But the moſt convincing proof of the total abſence of copper in this inſtance was afforded by the following experiment: I expoſed the 17 grains of the greeniſh precipitate (*e*) to red-heat, in a crucible, and ſubjected the black-brown reſidue, which weighed ſeven grains, to vigorous digeſtion in nitric acid. By this treatment, a ſlight quantity of iron, originating from the Pruſſian alkali employed for the precipitation, was depoſited; and all the remainder afforded a green ſolution with nitric acid. This I diſtributed into two phials; putting into the one a piece of poliſhed iron, and into the other a ſtick of zinc. But in neither of them, both in the cold or heated, could the leaſt indication of copper be obſerved.

g) After I was thus fully certain that no copper was preſent, I could not account for this conſtituent part of chryſopraſe, otherwiſe than by taking it for *oxyded nickel*.

This concluſion was corroborated by all the phenomena above-mentioned, which wholly reſembled thoſe of other experiments which I made, by way of trial, with an oxyd, prepared from the utmoſt pure reguline nickel.

Being accuſtomed to repeat thoſe experiments, which lead to new diſcoveries, in order to ſecure myſelf, by the agreement of the reſults, againſt accidental miſtakes, I ſubjected another quantity of chryſopraſe to analyſis.

The blue ſolution of oxyd of nickel in ammoniac, which I then obtained, I diſtilled to dryneſs from a retort; after which, I roaſted the reſidue with wax, in a gentle heat, and tried to reduce it to the reguline ſtate upon charcoal, by means of borax and fuſible phoſphoric ſalt. The reduction ſucceeded with either flux; but it required to be ſtrongly aſſiſted by the blow-pipe. While reducing with borax, the metal would not eaſily run into a button; but, with the phoſphoric ſalt, it proved ſomewhat more fuſible, and yielded a white-grey bead, that exhibited a ſhining polyhedral ſurface, and a finely grained fracture.

Theſe metallic buttons were too few to admit of a farther examination. For this reaſon, I endeavoured to procure more of them, which I effected by decompoſing the green earth of chryſopraſe, deſcribed in the following ſection; and the third ſection will ſhew, that thoſe ſeven grains of the precipitate obtained by Pruſſian alkali, and ignited (*f*), denote 2¼ grains of metallic nickel; or three grains of pure *oxyd of nickel*, when heated to redneſs.

Whence the conſtituent parts, produced from the 300 grains of *chryſopraſe* decompoſed, are:

Silex	*a*)	268¼	288,50 grs.
——	*b*)	20¼	
Alumine	*c*)		0,25
Lime	*d*)		2,50
Oxyd of iron	*c*)		0,25
Oxyd of nickel	*g*)		3
			294,50
Loſs, which the chryſopraſe ſuffers by ignition, and chiefly conſiſts of particles of water	*a*)		5,50
			300

With this proportion of the conſtituent parts of chryſopraſe, the reſults of ſeveral of my experiments agree pretty well. Yet I readily admit, that, on repeating ſuch experiments, ſome ſmall differences may take place, eſpecially in the portions of iron and nickel, ſince the green colour of this foſſil ſo often varies. In like manner, I have ſometimes diſcovered more ſenſible indications of magneſian earth, though never amounting to more than ⅛ *per cent.*

SECOND SECTION.

Analyſis of the Green Earth of Chryſopraſe.

a) Among the varieties of the glittering, fattiſh, green earth, that ſometimes accompanies chryſopraſe, I ſelected that for the preſent enquiry, which by its uniform apple-green colour is diſtinguiſhed from the others, as the moſt pure and leaſt contaminated with heterogeneous matters. Upon *three hundred* grains of this, put in a retort, I poured four times their weight of an *aqua regia*, compoſed of three parts of muriatic, and one of nitric acid, and at firſt digeſted them for a while. The action of the acid upon the earth was attended with an extrication of yellowiſh vapours. That portion of the acid which paſſed over was poured back into the retort, with the addition of one part of freſh nitric acid; and, after a ſecond digeſtion, diſtilled off to moderate dryneſs. The remaining maſs, whoſe green colour was now changed into a yellow, was again digeſted with the acid that had been abſtracted, and next ſeparated by filtering from the indiſſolvable reſidue.

b) This reſidue, which reſiſted the attack of the digeſting acid, conſiſted of a very tender, looſe, dazzling-white, and glittering *ſiliceous earth*, that weighed 105 grains after deſiccation in a red-heat. I mingled and ignited it with 210 grains of carbonated pot-aſh; upon which I triturated the maſs with water, ſuper-ſaturated it with nitric acid, digeſted and filtered it. In the fluid that paſſed through the paper nothing could be found, except *one grain* of ſilex.

c) The ſolution, ſeparated from the ſilex (*a*), had a green colour. It was combined with carbonat of pot-aſh, and the precipitate produced was edulcorated and dried in the air. This precipitate had a pale green colour, like the crude earth, and weighed 280 grains. By way of previous examination, I diſſolved *one fifth part* of it in muriatic acid, and tried the ſolution, which again exhibited its original green colour, in the following manner:

α) *Ammoniac* threw down a white green precipitate, which, on adding more ammoniac, in part re-diſſolved, and produced a blue tincture.

β) By means of *pruſſiated pot-aſh*, a copious ſea-green precipitate, inclining to blue, fell down.

γ) *Tincture of nut-galls* produced a faint ink-colour.

δ) With *alkaline ſulphuret* there aroſe a blackiſh precipitate.

ε) In the remainder of that fifth part of the muriatic ſolution I immerſed a *poliſhed iron*, which became tarniſhed, of a grey colour; but no ſign of copper, either in a cold or a warm temperature, appeared.

d) The other four-fifth parts of the green precipitate (*c*), which now contained one half ounce of rough earth of chryſopraſe, cleared from ſilex, were diſſolved in nitric acid, and treated with an over-proportion of carbonated ammoniac, ſhaking it ſeveral times. The ſupernatant blue ſolution was decanted on the next day from the reſidue; and to this laſt freſh portions of ammoniac were repeatedly added, till it ceaſed to afford a blue tincture, that could be obſerved.

e) The reſidue, left after the extraction by ammoniac, was a looſe white-grey earth, weighing 85 grains when dried in the air. It was diſſolved by digeſtion in nitro-muriatic acid, and treated with cauſtic ammoniac, until nothing more fell down. The light-brown precipitate then obtained was heated to redneſs; after which it weighed 26 grains. Nitric acid was next affuſed upon it in a retort, and again abſtracted by diſtillation; and this abſtraction and digeſtion were repeated twice more. I then urged the fire of the coals ſo as to redden the retort, powdered the calcined reſidue, diſſolved it in dilute nitric acid, and threw it upon the filter. There remained a red *oxyd of iron*, which, dried and deflagrated with wax, was attracted by the magnet, and weighed eleven grains.

f) The

had been employed for this inveſtigation, are the following:

Silex (ſince 105 grains were obtained from 300 grains of that earth)	*b*)		84 grains
Alumine	*f*)		12
Magneſia	*f*)		3
Lime	*g*)		1
Oxyd of iron	*e*)		11
Oxyd of nickel	*h*)	3½	37,50
———	*k*)	25	
———	*l*)	9	
			148,50
Loſs, very nearly approaching that which the rough earth of chryſopraſe ſuffers by red-heat			91,50
			240

THIRD SECTION.

Cloſer Examination of the Portion of Nickel contained in Chryſopraſe, and its concomitant Green-earth.

IN order to examine more accurately the whitiſh-green metallic oxyd that enters into chryſopraſe, as well as its concomitant green-earth, I procured another quantity of it, by repeated decompoſitions of thoſe two ſubſtances, performed in the manner before deſcribed. This I ſubjected to the following experiments.

a) Treated with *ammoniac*, it ſoon diſſolved; and yielded a pure blue tincture, though leſs ſaturated than that which is afforded by the ſolution of copper in ammoniac, made with he ſame proportion of theſe reſpective ingredients. If nitric cid be affuſed in a quantity a little beyond what is neceſſary o ſaturate the ammoniac, the ſolution appears of a light graſs green.

b) It entirely diſſolved, and with efferveſcence, in *ſulphuric acid.* It likewiſe gave with this a green ſolution; om which

α) *Carbonated pot-aſh* precipitated that oxyd of a whitiſh-green.

β) *Pruſſian alkali* of the ſame, but ſomewhat darker colour.

γ) *Tincture of galls* produced no change nor turbidneſs in the ſolution.

δ) *Arſeniated alkaline ſulphuret* threw down a great quantity of a black-brown precipitate; but of which

ε) Neither on *poliſhed iron*, nor on *zinc*, any thing of a metallic nature would depoſit; the ſolution producing only ſome weak, grey ſpots on theſe metals.

ζ) By expoſure to open air, this ſolution ſhot into clear, emerald-green, rhomboidal cryſtals of *ſulphated nickel*, which, by roaſting, crumbled into a white-greeniſh powder.

c) The green oxyd of nickel, tried upon charcoal, with a blow pipe, ſhewed the following appearances:—

α) Ignited by itſelf, it became *violet*; but ſhewed no diſpoſition to fuſe.

β) With *borax*, aſſiſted by a continued ſtream of air from the blow-pipe, it fuſed, and was partially reduced to a white-grey metallic maſs; but which would not run into one ſingle button.

γ) *Phoſphated alkali* likewiſe reduced it to the reguline ſtate, at the ſame time that it more readily united into one bead. The glaſs globule exhibited, during the action of heat, a garnet-red, but, after refrigeration, a hyacinthine colour.

d) I now attempted its reduction in the *crucible*. With this deſign, I introduced the 15 grains of metallic oxyd, remaining after ignition from thoſe 30 grains mentioned (2 Sect. *k*), into a crucible, previouſly mixed with the ſame quantity of reſin, and three times that of calcined borax, and covered the whole with common ſalt. The veſſel was then conveyed to the melting-furnace, and the fire managed in about the ſame manner as on aſſaying copper. After cooling, the inſide of the crucible was found lined with a thin glazing, on ſome places of the upper part, of a green, but on the lower one, of a bright hyacinthine colour. The maſs itſelf fuſed well; and, on breaking the veſſel, there was found, under the colourleſs ſaline cover, a tranſparent light-brown glaſs, and, between this, a metallic button. This, however, being refractory, had not run into a compact maſs, but was only conglutinated, conſiſting of ſeparate, ſmall, looſely-coherent globules.

This metal had a perfect metallic luſtre, and a grey colour, verging to the red When freed by elutriation from the adhering ſcoria, it weighed 9¼ grains. But as here and there ſome minute grains were ſticking to the fragments of the crucible, not eaſily ſeparable, I may prorly eſtimate them at ¼ grain; wherefore the weight of *metallic nickel* is determined at 10 grains.

α) The *magnet* has attracted theſe metallic grains with ſuch rapidity, that, on its approach, the whole quantity adhered to it in an inſtant; and not one ſingle globule remained behind.

β) One grain of them by weight afforded, with *ſulphuric acid*, aſſiſted by heat, a graſs-green ſolution; from which

γ) *Ammoniac* again precipitated the metallic part, of a bright whitiſh-green; but, on being affuſed in greater quantity, it ſoon re-diſſolved it clearly, and of a ſky-blue colour.

δ) *Five* grains of this reduced nickel, diſſolved in *nitric acid*, and thrown down by *Pruſſian alkali*, then edulcorated and dried, gave a ſea-green precipitate; which, expoſed to red-heat, left 15 grains of a granular reſidue, wholly attractible by the magnet.

ε) Thoſe metallic grains urged by the flame upon charcoal, before the blow-pipe, exhibited no diſpoſition to melt, or fuſe, but turned to a greeniſh oxyd.

ζ) When fuſed with *borax*, they likewiſe would not readily enter into fuſion. The glaſs of borax turned aſh-grey and opake; and the metal remained in it in a divided ſtate.

η) But with fuſible *phoſphoric ſalt* they melted pretty ſoon into one ſingle bead, of a polyhedral ſurface. The glaſs globule, which, during the action of heat, was of a deep garnet-red, became tranſparent after cooling, and aſſumed a fine hyacinth colour.

e) Notwithſtanding that all theſe facts, taken together, ſufficiently demonſtrate that the conſtituent part of chryſopraſe, from which its peculiar green colour ariſes, is a *true oxyd of nickel*; yet I have, for the ſake of ſuperabundant evidence, made other experiments with an oxyd of nickel, which I prepared by the following method.

A portion of *ore of nickel*, from the pit *König David*, on the *Sauberg*, at *Annaberg*, was coarſely pounded, the pureſt pieces ſelected, converted into a groſs powder, and roaſted in ſhallow pots, as long as any arſenical vapour exhaled. The powdered ore acquired, by this, a dirty green colour, and vegetated, in part, into ramified figures. This oxyd of nickel I reduced with black flux, and obtained a yellowiſh-white, brittle, metallic button, of eaſy fuſion. This, being once more calcined, was digeſted in a retort, with an equal quantity of ſtrong ſulphuric acid; after which the acid was again diſtilled over to dryneſs, and the reſidue re-diſſolved in water, and filtered. At the beginning, the ſolution depoſited ſmall cryſtals of arſenic; and when theſe had been removed, the ſulphated nickel ſhot into beautiful, deep-green, rhomboidal cryſtals. This vitriol of nickel I again diſſolved in water, and precipitated it by means of carbonated pot-aſh. Upon the oxyd of nickel thus obtained, when waſhed, dried, and pulverized, ammoniac was affuſed. This laſt ſoon extracted a fine blue tincture, which, filtered off from the reſidue, was ſaturated with nitric acid; and, by means of mild pot-aſh, all the whitiſh-green earth which it would yield was precipitated from it.

With this oxyd of nickel, extracted in this way from its ore, I have inſtituted various experiments, for the ſake of trial; which, to avoid prolixity, I ſhall not particularly enumerate. I will, therefore, only ſtate, that this oxyd, as to the eſſential phenomena, has perfectly agreed with that extracted from chryſopraſe.

f) Thoſe who deſire information reſpecting the habitudes of nickel in general, I refer to the valuable treatiſe of *Bergmann* * on that metal; where he relates his experiments, made with unwearied patience, for the purpoſe of extracting the regulus of nickel, in a ſtate of purity, from its ores; in which it is conſtantly accompanied by foreign metallic ſubſtances. The difficulties which take place in thoſe proceſſes, I have found confirmed by my own experiments: but I think the beſt method of obtaining the reguline part of nickel is that deſcribed above; namely, by means of ammoniac: yet the product becomes ſomewhat expenſive.

In the chryſopraſe, on the contrary, the oxyd of nickel is not mixed with other metallic matters, a very ſlight portion of iron excepted; and ſince the proceſs which I have there given likewiſe ſerves to ſeparate this inconſiderable ferruginous ingredient, we may ſafely conſider the *metallic nickel*, produced from chryſopraſe, or its accompanying green earth, to exiſt in the ſtate of the *utmoſt poſſible purity*.

g) To this aſſertion, however, it may, perhaps, be objected, that the nickel obtained in that way ſtill obeys the magnet, and, therefore, yet contains ſome iron. But has it as yet been unqueſtionably proved, that iron alone is ſubjected to the law of magnetic attraction?—Have the arguments which various philoſophers have brought forward

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* *Torb. Bergmann* Opuſc. Phys. et Chim. vol. II. page 231. *De Niccolo.*

ſt this ſuppoſition, been completely refuted?—When
hemiſt no longer finds any trace of iron in pure co-
or in pure nickel, and, nevertheleſs, obſerves the mag-
act upon it—can his doubt, whether the attractive
of the magnet be confined only to iron, as has been
rto believed, be fairly rejected without any farther in-
gation?

I muſt yet mention ſome *experiments relative to vitrifi-*
n, for which I have uſed the rough chryſopraſe, as
as the oxyd of nickel extracted from it, in combination
various other vitrifying media.

α) *Rough chryſopraſe*, finely powdered and elutriated, ...	1 part,
Carbonated pot-aſh, ...	2 parts,

d and fuſed in a crucible, afforded a violet-blue glaſs,
h deliqueſced in the air to a browniſh fluid.

β) *Rough chryſopraſe* . . .	5 parts,

mentioned a bead of reduced nickel, obtained from chryſopraſe by reducing fluxes; but he miſtook its nature, erroneouſly conſidering it as iron.

δ) *Rough chryſopraſe*, and
Calcined borax, in equal quantities,

gave a brown tranſparent glaſs, reſembling rock-cryſtal of that colour. *(Rauch-topas).*

ε) Prepared *ſiliceous earth* . .	80 grains,
Carbonated pot-aſh . . .	60
Oxyd of nickel, from chryſopraſe	3

yielded a clear, violet-blue glaſs.

ζ) Prepared *ſiliceous earth* . .	80 grains,
Carbonated pot-aſh . . .	60
Oxyd of nickel, from the ore of that metal of *Annaberg*, obtained by the proceſs mentioned at *(e)* . . .	3

By this experiment I obtained a glaſs of a violet-blue colour, perfectly reſembling the laſt.

η) Prepared *ſiliceous earth*,	
Burnt *borax*; of each . . .	60 grains of each
Oxyd of nickel from *chryſopraſe*	3

produced a clear, light-brown glaſs.

θ) Prepared *ſiliceous earth*	
Vitrified *phoſphoric acid*, prepared from bones,	60 grains of each
Oxyd of nickel from *chryſopraſe*	3 grains,

have afforded a honey-yellow glaſs; but which did not become entirely clear.

i) Of the various inferences that may be drawn from the preceding facts, I will ſelect only a few.

Lehmann, to my knowledge, was the firſt, who obſerved that chryſopraſe affords a *blue glaſs* by fuſion with carbonat of pot-aſh. This obſervation is confirmed by the experiments of *Achard*, made on the ſubject of the fuſibility of various ſubſtances. The foregoing experiment (ι) ſhews, that this blue colour ſolely depends on the portion of nickel contained in chryſopraſe; and it is proved, by the experiment (ζ), that the oxyd of nickel, if freed, as much as is practicable, from extraneous admixtures, poſſeſſes the property of tinging glaſs-frits, mixed with mild pot-aſh, of a *blue* colour, on their vitrification. But what can be the reaſon, that this blue colour is not produced by means of mild ſoda employed in the ſame manner? To what cauſe is that difference to be aſcribed?

The ſame experiments alſo prove that *Le Sage* * was in the wrong, when he aſſerted that the metallic ingredient in chryſopraſe is cobalt. Beſides cobalt, we now know ſeveral metallic ſubſtances capable of producing a blue glaſs, under certain conditions, with which the chemiſt ſhould be thoroughly acquainted, before he infers from this the nature of any metallic ſubſtance. Thus, *cobalt* covers all fluxes, (enamels, glaſs-paſtes) blue; while *oxyd of wolfram* (tungſten) imparts a blue colour to ſuch frits only as are mixed with phoſphoric ſalts, leaving, on the contrary, thoſe colourleſs that are combined with borax. In like manner, the *oxyd of nickel* tinges blue the frits prepared with carbonat of pot-aſh; but brown, thoſe into which carbonat of ſoda, or borax, enters; and, laſtly, it produces a *honey-yellow* in ſuch as are mixed with a neutral phoſphat.

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* See *Analyſe Chimique et Concordance des Trois Règnes*, par Mr. *Sage*, tom. II. Paris, 1786, page 73.

Since, therefore, chryſopraſe does not afford a blue, but a *brown* glaſs, when melted with borax; this fact, together with the knowledge that no trace of any green ſympathetic ink is diſcovered in its muriatic ſolution, is alone a ſufficient evidence of the abſence of any portion of cobalt from that foſſil. *Le Sage* tells us, indeed, he has produced a blue glaſs from chryſopraſe and borax; but again this aſſertion of his does not correſpond with experience.

XLV.

CHEMICAL EXAMINATION OF THE *NOBLE OPAL*,

From Cscherwenitza, in Upper-Hungary.

If the *Noble Opal*, effulgent with variegated colours (*chatoyant*) be contraſted with the colourleſs *rock-cryſtal* and the dull, dark coloured *flint*, it would hardly be poſſible, were it not for the conviction afforded by chemical experience, to be perſuaded that the chief conſtituent part of thoſe three ſpecies of ſtones, ſo diſſimilar in their external appearance, is the ſame ſimple, pure, ſiliceous earth, or, at leaſt, only in exceedingly ſmall proportions, mingled with foreign ingredients; and that it is only the difference in the ſtate of aggregation which modifies the one to opal, the other to rock-cryſtal, and the third to flint.

But that the *noble opal** really belongs to the pureſt ſorts of ſilex, is demonſtrated by the following analyſis.

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* *Eſtner* has publiſhed in his *Mineralogy*, vol. II. page 402 ſeq. an ample deſcription of this beautiful ſtone; taken principally from the valuable opals in the Imperial Cabinet at Vienna, ſo diſtinguiſhed by their beauty and magnitude; and, beſides, from thoſe in the collection of opals of Abbé *Neumann*, Director of the Imperial Cabinet of Medals, which, perhaps, is the moſt complete in its kind. Of the accurate agreement of thoſe deſcriptions with the originals, I had the pleaſure of convincing myſelf by my own inſpection, at Vienna.

A.

A piece of rough, or unwrought noble opal, weighing 76½ grains, was expoſed to fire, in a well-covered porcelain-veſſel. It crackled at the very firſt degree of heating. When the noiſe cauſed by this had ceaſed, it was kept in ignition for half an hour longer. After cooling, it was found burſt into ſmall flaty ſplinters, of a pure milk-white, and a ſurface partly glittering, partly of an enamel-luſtre. The yellowiſh ferruginous covering, which is perceivable even in the rough ſtone, and penetrates its extremely minutes fiſſures, was changed, by the ignition, to a *high-yellow-red*, and, in part, *irideſcent*, or exhibiting changes of rainbow colours. It experienced a loſs of weight of 7½ grains, or about 10 per cent.

B.

a) *Hundred grains* of rough, noble opal, finely-pulverized in the flint mortar with water, were mixed, after exſiccation, with 200 grains of dry carbonated ſoda, and ſubjected to moderate red-heat for two hours, in a ſilver-crucible.

The maſs, which but looſely coaleſced, was then triturated, ſoftened with water, ſuper-ſaturated with muriatic acid, and briſkly digeſted. The fluid formed a gelatinous coagulum as it cooled. When diluted with more water, and again digeſted, it was filtered, and the *ſiliceous earth* remaining on the paper thoroughly lixiviated, and ignited, after previous drying. It then weighed 90 grains.

c) The muriatic liquor was reduced to a ſmall bulk by *evaporation, and treated with* cauſtic ammoniac, added in ex-in this ſtate, ſuſceptible of receiving impreſſions from hard bodies.

a) *One hundred* grains of this Saxon hydrophanes were coarſely divided or bruiſed, and ignited upon red-hot coals, in a ſmall glaſs retort. At the end of this proceſs there appeared, in the receiver, an empyreumatic water, covered with a thin greaſy pellicle. The loſs of weight ariſing from this was 5¼ grains.

b) The ignited hydrophanes was then triturated to a ſubtle powder, mixed with twice its weight of carbonated ſoda, and kept in a moderate heat for two hours. When the maſs had cooled, it was powdered, ſuper-ſaturated, and digeſted with dilute muriatic acid. This done, the muriatic fluid filtered off from the *ſiliceous earth*, that had much ſwelled, together with the lixiviating water, was concentrated by evaporation, and ſaturated with cauſtic ammoniac; by which, however, only a ſmall precipitate was produced, conſiſting of pure *alumine*, unmixed with iron, and weighing 1⅝ grains after ignition. Nothing farther was found in the remaining liquor.

Hundred parts of this *hydrophanes*, from *Saxony*, therefore contain:

Silex	93,125
Alumine	1,625
Volatile inflammable parts, and *water*	5,250
	100

If this hydrophanes, after complete expulſion of its aqueous moiſture, be ſteeped in melted wax or ſpermaceti, in which ſtate of artificial preparation it is called *pyrophanes*, it acquires the property of being quite tranſlucid, and of brown yellow or grey colour, when heated in a ſpoon upon a charcoal fire.

XLVII

XLVII.

CHEMICAL EXAMINATION
OF THE
WHITE AND GREEN OPAL

From Koſemütz *.

AMONG the different ſtones that accompany the chryſopraſe in its veins, on the mountainous diſtrict of *Koſemütz*, there alſo occur various ſorts of opal, which ought to be claſſed partly with the *common* (dull) *opal*, partly with the *ſemi-opal*. They are there found chiefly of four colours, viz. green, reddiſh, yellow, and milk-white; of which the three laſt varieties belong to the *common-opal*, and moſtly lie on a grey and browniſh hornſtone.

The ſubject of this enquiry was the *milk-white*, *inclining to the blueiſh and tranſparent* variety of that *common-opal*.

a) *Half an ounce* of this foſſil, moſt finely levigated, and intimately mingled with one ounce of deſiccated ſoda, was moderately ignited for two hours. The maſs, obtained and ground to powder, was ſaturated to exceſs with dilute muriatic acid; then evaporated nearly to dryneſs, again diluted with water, and finally thrown upon the filter The reſidue, lixiviated, dried, and ignited, gave 237 grains of *ſiliceous earth*.

b) The fluid, diminiſhed by evaporation, and combined with cauſtic ammoniac, afforded a ſlight quantity of a browniſh precipitate. As the remaining liquor continued unaltered, on being combined with carbonat of ſoda, it ſhewed, by this, that it held no other ſubſtance in ſolution.

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* *Beobachtungen und Entdeckungen aus der Naturkunde.* Berlin, 1788, vol. II. page 45.

c) When the precipitate, obtained by means of cauſtic ammoniac, had been rediſſolved in muriatic acid, and treated with pruſſiat of pot-aſh, it afforded ſome Pruſſian blue, of which the *oxyd of iron*, that enters as a conſtituent part into this opal, was, at moſt, one-quarter of a grain. After its ſeparation, carbonat of ſoda ſtill precipitated half a grain of *aluminous earth*, which, upon ignition, could not be eſtimated at more than one-quarter of a grain.

This *common opal*, therefore, chiefly conſiſts of mere ſiliceous earth; for *one half* ounce of it yielded:

Silex	237 grains.
Alumine	0,25
Oxyd of iron . . .	0,25
	237,50
Loſs . .	2,50
	240 grs. or ½ oz.

The *apple-green* variety of thoſe opals from *Koſemütz*, which it will be more proper to rank under the *ſemi-opal*, penetrates like the chryſopraſe, in clefts or veins, of from one-half to one full inch thickneſs, thoſe maſſes of earths and ſtones, which lie promiſcuouſly in irregular ſtrata in the mountains which afford chryſopraſe. The conſtituent parts of this green ſemi-opal are likewiſe thoſe of the foregoing common white opal, only that it contains about *one per cent.* of *oxyded nickel*, from which, likewiſe, its green colour, like that of chryſopraſe, originates.

XLVIII.

XLVIII.

CHEMICAL EXAMINATION

OF THE

YELLOW OPAL from Telkebanya.

FOR the analyſis of this ſpecies of opal, expreſſed by the name *pitch-opal*, *telkebanya-ſtone*, I ſelected that clear greeniſh-yellow variety, which in groſs ſplinters reſembles the *bright-yellow* common *amber* (electrum, ſuccinum).

a) *Hundred* grains of it, broken into coarſe fragments, were ſubjected to red-heat for half an hour in a covered crucible. The ſtone flew in pieces, with a moderate decrepitation or crackling noiſe. It was ſlightly tranſparent, after this ignition, but only on the edges; its colour alſo changed into a pale brown-yellow, and the loſs of weight, which it ſuſtained, amounted to five grains. At the ſame time it became very ſoft, and allowed of being eaſily ground to a ſubtle iſabella-yellow powder.

A ſtronger heat renders this opal greyiſh-white. The ſlight portion of iron which it contains, and from which it derived its colour, is reduced, in this proceſs, to the reguline ſtate; and, by means of a good magnifying lens, extremely fine grains of iron, that have tranſuded, may then be diſcovered *.

b) The above-mentioned 95 grains of ignited and pulverized opal were mixed with 200 grains of effloreſced mild ſoda, or ſuch as had loſt its water of cryſtallization in the air; and in that ſituation expoſed to, and maintained in, a moderate red-heat during the ſpace of one hour. The mixture came out of the fire quite white, and but looſely conglutinated. It was next ſoftened with water; ſuperſaturated with muriatic acid; concentrated by evaporation to a jelly; once more diluted with water; and, laſtly, thrown upon the filter. The *ſiliceous earth*, which, by this management, remained behind on the paper, weighed 93½ grains, when ignited.

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* *See Eſſay I. No. 66.*

c) I then treated the colourleſs muriatic fluid with cauſtic ammoniac, added in an over proportion. But only a few brown flakes ſeparated, which, when collected and ignited, afforded one grain of oxyd of iron. The remainder of the fluid contained no other ingredient.

Accordingly, *hundred* grains of this *yellow opal*, from *Telkebanya*, conſiſt of:

Silex	93,50
Oxyd of iron . . .	1
Water	5
	99,50

XLIX.

CHEMICAL EXAMINATION

OF THE

ROWN-RED SEMI-OPAL

From Telkebanya.

foſſil, which occurs but ſeldom in the Telkebanya-
ins, and by ſome has been erroneouſly conſidered as
tch-ſtone, poſſeſſes a brown-red colour; is maſſive, and
erate brilliance. Its fracture is flat conchoidal, and
ure compact and ſmooth. It is opake, brittle, and
aſily. By reduction to a fine pulverulent ſtate, it
s a fully ſaturated deep-red colour, ſimilar to that of
ed reſin, called dragon's-blood. Its ſpecific gravity
to be 2,540.

Vhen entire pieces of it were ſtrongly ignited for
hour, in a covered crucible, it neither flew in pieces,
erienced any change of colour; but it loſt 7½ *per*
weight.

vhen expoſed to the more intenſe heat of the porce-
nace, the phenomena take place, which have been
ed in Eſſay I. No. 65. For, if ignited in the *char-*
ible, a great number of grains of iron tranſude, and
ture of the ſtone becomes grey, dull, earthy, very
nd porous, like ſpunge. If ignited in the *clay-cruci-*
vhole ſurface is covered by a fine-ſcaly ferruginous
a metallic luſtre, and attractible by the load-ſtone.
deed, an unexpected phenomenon, and hence the
markable, that iron, ſo ſtrongly oxyded as it is when
d in this foſſil, has, in the latter inſtance, been re-

duced

ſtarted ſome doubts, in a letter to *de la Metherie* ‡, in conſequence of experiments which he has made, by moiſtening ſome pieces of the ſtone, and expoſing them for ſeveral months to open air; upon which he found, that ſulphat of magneſia had gradually been formed. By this he was perſuaded, that this ſpecies of ſtone belongs to the magneſian genus, and ſhould be added to the ſteatites, ſerpentine and pot-ſtone. With what propriety, will appear from what follows.

A.

From the pieces choſen for this enquiry I firſt ſeparated the earth adhering to their outſide. I then introduced *hundred* grains into a ſmall glaſs retort, inſerting its neck into a bottle containing lime-water. The retort was placed between the coals, or in open fire, and the heat gradually increaſed to the ignition of its contents. At the very beginning there paſſed over ſome drops of water, and ſoon after I ſaw the lime-water in the receiver growing turbid. In this laſt, when the receiver had been removed, I perceived a bituminous-empyreumatic ſmell, which, at firſt, alſo ſeemed to be ſomewhat ammoniacal. The pieces of the ſtone in the retort were rendered black and reſplendent, like jet *(Gagas)*, and had loſt eight grains. But by a ſtill ſtronger ignition in an open crucible, they loſt again that black colour, and became at firſt blueiſh, then grey-white, loſing, at the ſame time, three grains more in weight.

I then combined them, previouſly ground to fine powder, with double their quantity of carbonated pot-aſh, and put them into an open fire, in a ſilver crucible. The mixture entered into fuſion, without my intending it, and foamed ſo

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* *Journal de Phyſique*, Paris, Fevr. 1789.

ſtrongly

ly that it lifted up the lid of the veſſel, and run over . Seeing this, I directly withdrew the crucible from ;, and found that the remaining portion of the maſs had into a clear greeniſh glaſs; which, as it cooled, at- moiſture from the air, and diſſolved entirely in a ater.

ough I could not farther proceed in this examination, ount of having loſt part of the maſs; yet I foreſaw, eſe facts, that this foſſil is not a very compounded of ſtone, but rather that it is likely to conſiſt almoſt en- f mere ſiliceous earth. This conjecture was again ed by the following experiment.

B.

reduced *one hundred* grains of the rough ſtone to an ble powder; and having mixed them with twice eight of carbonated pot-aſh, I ignited the mixture in crucible, during five hours, in a degree of heat ſo te, that there was no danger of its fuſing. When ed, it diſſolved in water, aſſiſted by heat, leaving ew undiſſolved particles. By ſuper-ſaturation with c acid, the mixture congealed to a thick, intumeſced After farther dilution with water, digeſtion, and ;, there remained 84 grains of *ſiliceous earth*, upon aſhed, dried, and heated to redneſs.

hen the fluid, ſeparated from this laſt, had been con- d by evaporation, and, while yet hot, ſaturated with la, a browniſh-white precipitate fell down; which, -diſſolved in nitro-muriatic acid, there ſtill ſeparated *iceous earth*, weighing 1½ grain, when ignited.

he liquor, freed from this, was treated with Pruſſian and the quantity of the blue precipitate then produced indicated half a grain of *oxyd of iron*, attractible by the magnet. After the ſeparation of this laſt, *aluminous earth*, weighing one grain in the ignited ſtate, was thrown down by cauſtic ammoniac. Carbonated ſoda, with the aſſiſtance of heat, precipitated from the remaining fluid a ſlight portion of looſe earth; which, after ignition, ſcarcely weighed half a grain, and, upon trial by ſulphuric acid, ſhowed itſelf to be *calcareous earth*, accompanied by a trace of *magneſia*.

In conſequence of this analyſis, *hundred* parts of *menilite* contain:

Silex	85,50
Alumine	1
Oxyd of iron	0,50
Lime	0,50
Water and carbonic matter	11,
	98,50

From the conſtituent parts here produced, it is obvious, that this foſſil can, by no means, belong to ſteatites, or to ſerpentine, or to the pitch-ſtone, as the proportions of theſe ingredients, in conjunction with the infuſibility of *menilite*[*], ſufficiently prove. Perhaps this foſſil may be conſidered as a variety of the *ſemi-opal*, approaching to flint (*Feuerſtein*).

The inconſiderable trace of magneſia does not ſeem to belong to the mixture or compoſition of this foſſil. It rather originates from particles, that have entered into it from its matrix, which contains a ſmall portion of magneſia, as will appear by the following analyſis.

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[*] See Eſſay I. No. 69.

LI.

CHEMICAL EXAMINATION OF THE *POLISHING-SLATE*

(*Polierſchieſer of Werner.*)

From Menil-montant.[*]

THE *poliſhing-ſlate*, found at *Menil-montant*, which ſerves as a matrix to the *menilite*, ſpoken of in the laſt Eſſay, poſſeſſes a bright white-grey colour; is meager and rough; of a dull earthy fracture; ſtrongly adhering to the tongue; and ſplit, in a ſlaty manner, by ſlender horizontal rifts. Its ſpecific gravity is only 2,080. When thrown into water, it imbibes it with a crackling noiſe, and copious air-bubbles are diſengaged. By trituration it affords a very looſe powder, which, on ignition, loſes 19 in the hundred, and acquires thereby a pale red colour.

I ſhall not relate in detail the method by which I performed its decompoſition, as it was the ſame with that of the preceding foſſil. But I ſhall only mention the reſult, according to which the conſtituent parts of *poliſhing-ſlate*, and their proportions to one another, in the hundred, are:

Silex	66,50
Alumine	7
Oxyd of iron	2,50
Magneſia	1,50
Lime	1,25
Water	19
	97,75

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[*] *Chemiſche Annalen*, 1790. 2ter Theil. Seite 302.

LII.

CHEMICAL EXAMINATION

OF THE

SILICI-MURITE (*Meerſchaum.*)

From the Levant *

THE plaſtic *ſilici-murite* (*myrſen*, *kil*, *keffekil*) from *Eſki-Scheher*, in *Natolia*, the external characters of which, along with ſome obſervations upon it, have been given by *Kerſten* †, ſhould, on account of its exterior appearance, be rather added to the argillaceous genus, and in particular to the ſpecies of tripoli, than to the genus of magneſian earths, under which it has been placed ſince its analyſis, publiſhed by *Wiegleb* ‡

However, as it appears from the paper of *Wiegleb*, that the ſilici-murite decompoſed by him was not then in its crude native form, but had been wrought into tobacco-pipe heads, and as from this circumſtance it might become doubtful whether the foſſil, employed by him in that ſtate, was genuine; I thought it of ſome uſe to repeat his enquiry, by analyſing ſome genuine ſilici-murite in its natural ſtate.

For this purpoſe I ſelected two varieties; the firſt of which differed from the other, by a whiter colour, a ſomewhat ſmaller degree of hardneſs, and a greater looſeneſs when powdered.

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* *Beob. u. Entd. a. d. Naturkunde*, vol. V. Berlin, 1794, page 149.

† Loc. cit. page 143.

‡ *Neuſte Entdeckungen in der Chemie*, 5 Theil. Seite. 3.

A.

a) The ſpecific gravity of the whiter variety in pure
mps, freed from their porphyraceous matrix, is 1,600. Of
is I ſubjected *hundred* grains to a briſk red-heat in a cru-
ble, by which they loſt 30 grains. But, in other reſpects,
ey ſuffered no alteration obſervable in their external
pearance: as, by the reſult of a previous experiment, here-
er to be mentioned, the loſs of weight, which this foſſil
tains by ignition, is five parts of water and one of carbo-
c acid. The above loſs of 30 grains is, conſequently, di-
ded into 25 grains of *water* and five grains of *carbonic acid.*

b) The remaining ignited 70 grains were ground to a
ſt ſubtle powder, which I firſt worked with water to a
lpy conſiſtence. Half an ounce of ſtrong ſulphuric acid
s then added, and all the fluid diſtilled over to dryneſs.
he reſidue being ſoftened with boiling water, its undiſſolved
rtion was ſeparated by means of the filter. Which laſt,
ulcorated, dried, and ignited, conſiſted of 50½ grains of
hite, very looſe *ſiliceous earth.*

c) The clear, colourleſs liquor ſhewed, by the taſte, that
was a ſolution of *ſulphated magneſia.* When concentrated
evaporation, it depoſited, as it cooled, a ſmall quantity of
lenite, in tender ſpear-ſhaped cryſtals. This being de-
mpoſed by mild ammoniac, afforded one grain of carbonat-
lime, for which half a grain of pure *calcareous earth* muſt
reckoned.

d) When the ſelenite or ſulphated lime had been ſeparated,
e ſolution yielded, by cryſtallization, only ſulphat of mag-
ſia. From this ſalt, re-diſſolved in water, and decompoſed
a boiling heat, by carbonat of pot-aſh, 37½ grains of car-

bonated magneſia were obtained, which were reduced, after an hour's ignition, to 17¼ of pure *magneſia.*

An *hundred* parts of this *whiter ſilici-murite*, therefore, contain:

Silex . . .	*b*) . . .	50,50
Magneſia . . .	*d*) . . .	17,25
Lime	*c*) . . .	0,50
Water	*a*) . . .	25
Carbonic acid . .	*a*) . . .	5
		98,25

I could not aſcertain, in the *humid way*, the proportion of the carbonic acid ingredient in this foſſil; ſince acids do not completely diſſolve or decompoſe it in the cold, and hence do not at all efferveſce with it, or only imperceptibly. For this reaſon, I attempted it in the *dry way*. I introduced 200 grains of pulverized ſilici-murite into a ſmall glaſs retort, connected with the hydrargyro-pneumatic apparatus, and kept it in ignition until the veſſel was near fuſing. The water that paſſed over I collected in the intermediate ſmall ſpherical cavity of the conducting pipe, while the gas was caught in a receiver above the mercury. The water weighed 35 grains. It was yellowiſh, and emitted a ſmell like petroleum; it alſo manifeſted an obſcure veſtige of ammoniac, which, however, was ſoon after ſucceeded by a feeble trace of an acid. But the gas, deducting the common air contained in the apparatus, amounted to 13 cubic inches, whoſe weight is nearly ſeven grains. This was entirely abſorbed by lime-water, from which it precipitated carbonated lime or crude calcareous earth.

B.

The *other ſort of ſilici-murite*, the colour of which inclined to the grey, loſt 39 grains in the *hundred*, and acquired by it

the

whiteneſs of chalk. Its decompoſition was performed in the ſame manner as that of the foregoing. In the reſult, the folloing appeared to be its conſtituent parts in the *hundred*;

Silex	41
Magneſia	18,25
Lime	0,50
Water and carbonic acid. .	39
	98,75

Beſides theſe two varieties of ſilici-murite, I have likewiſe analyſed a third, in which I have found the proportion of magneſia conſiderably greater, but that of ſilex much ſmaller in the ſame ratio. But as this conſiſted of one ſingle fragment only, I was not able to repeat the experiment. Yet I mention this, becauſe it ſhews that Nature does not always obſerve an invariable proportion in the two chief conſtituent parts of ſilici-murite; as, indeed, is alſo the caſe with reſpect to various other foſſils.

LIII.

CHEMICAL EXAMINATION
OF THE
SEMI-INDURATED STEATITES.

(Speckſtein of Werner.)

From Bareuth.

THOUGH the *common Steatites*, which occurs at *Göpfersgrün*, near *Wunſiedel*, in the principality of *Bareuth*, is found in conſiderable quantity, yet it has till now been met with only in detached, larger or ſmaller, reniform lumps. It is diſtinguiſhed from other ſpecies of ſtones of the ſame genus particularly by this, that it is found ſometimes in hexahedral priſmatic cryſtals, with ſix-ſided pyramidal terminations, and, but very lately, in double hexahedral pyramids[*], imbedded in maſſive indurated ſteatites.

a) *Two hundred* grains of this ſteatites, finely ſcraped by the knife, were ſubjected to red-heat, in a covered crucible, during one hour. They loſt by this 11 grains of weight, and the ignited powder of the ſtone received an iſabella-yellow colour.

b) This powder I mixed in a ſilver-crucible with a cauſtic lye, of which the alkaline part, or the pot-aſh, was double the weight of the pulverized ſtone; and, after having evaporated it to drynes, I kept it in ignition for half an hour. This maſs was again diſſolved in water, and digeſted with muriatic acid, added in exceſs. *Siliceous earth* was thus ſeparated, amounting to 119 grains, after waſhing, drying, and ignition.

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[*] This rare cryſtallization of the *Bareuth-ſteatites*, reſembling the double hexahedral, calcareous, Derbyſhire-ſpar, is found in the collection of Mr. *Frick*, Maſter of the Mint at Berlin.

c) The muriatic ſolution was combined with carbonat of pot-aſh, heated to the degree of ebullition. The browniſh precipitate, thereby produced, was treated with muriatic acid; the ſolution evaporated, and the dry ſaline maſs ſtrongly ignited during half an hour. Having re-diſſolved this ſaline maſs in water, and ſeparated the brown oxyd of iron by filtration, I combined the clear ſolution with carbonated pot-aſh, at the temperature of boiling. By theſe means, 147 grains of very looſe and white *magneſia* were precipitated. One half of this, re-diſſolved in ſulphuric acid, and cryſtallized, afforded pure ſulphat of magneſia. The other half, when heated to redneſs, weighed 30½ grains.

d) The brown-red oxyd of iron, that had ſeparated from the aqueous ſolution of the ignited ſaline maſs (*c*), weighed nine grains. But, as the portion of iron, exiſting in the mixture of ſteatites cannot be conſidered as perfectly oxyded, but only as being in the ſtate of an oxyd of iron, ſtill attractible by the magnet, I deflagrated linſeed-oil upon it, in a covered crucible.—This *oxyd of iron* now weighed only five grains.

According to this analyſis, the *Steatites* from *Bareuth* conſiſts, in *hundred* parts, of:

Silex	*b*)	59,50
Magneſia	*c*)	30,50
Oxyd of iron . . .	*d*)	2,50
Aqueous particles, driven out by a red-heat		5,50
		98

e) The ſulphuric ſolution (*d*), therefore, contained 67 grains of earth; which, precipitated by alkali, and examined in the uſual way, was found to be merely *aluminous earth*.

f) Of the firſt 192 grains of the earthy precipitate (*d*), 99 grains were taken up by the acetic acid. Theſe I likewiſe precipitated by means of carbonated pot-aſh. The earth thus obtained was tried by ſulphuric acid, and found to be mere *magneſia*.

Therefore *one ounce*, or 480 grains, of this *Steatites from Cornwall* have yielded:

Silex	*b*)	204 grs.	230 grs.
——	*d*)	26	
Magneſia	*f*)		99
Alumine	*e*)		67
Oxyd of iron	*c*)		3,75
Water	*a*)		75
			474,75
		Loſs	5,25
			480

Or, an *hundred* parts of it, averaging the ſmall fractions, contain:

Silex	48
Magneſia	20,50
Alumine	14
Oxyd of iron	1
Water	15,50
	99

LV.

CHEMICAL EXAMINATION

OF THE

CHINESE AGALMATOLITE.

(Plaſtic ſtone. Bildſtein.)

BY the name *Plaſtic Stone* (agalmatolithus), I denote that foſſil, which hitherto has been called *Steatites* from *China*; ſince this laſt denomination of it, as indicating a ſtone belonging to the magneſian, or muriatic genus, can no longer be retained with propriety, as will appear from the following analyſis of that foſſil.

The want of rough pieces of this ſtone I ſupplied by employing figures cut of it; the genuineneſs of which is rendered indiſputable by the known peculiar taſte or *character* of the Chineſe art.

On breaking ſeveral of theſe little carved figures, I obſerved that two varieties may be diſtinguiſhed of the ſtone uſed for them by the Chineſe artiſts; which I denominate the *tranſparent* and the *opake*.

A.

Tranſparent Chineſe Agalmatolite.

The colour of this is olive and aſparagus-green, verging through various ſhades to a greeniſh-blue. Inwardly it is very much glittering, and of a greaſy luſtre. The chief fracture is *indiſtinctly* thick-ſlaty, but the croſs-fracture evidently ſmall-ſplintery. It is ſtrongly tranſparent, inclining to the ſemi-tranſlucid; ſoft, and of a greaſy feel, &c. Its ſpecific gravity, 2,815.

a) Two hundred grains of this agalmatolite, finely ground, loſt 11 grains of weight by a moderate ignition for half an hour.

b) After the firſt ignition, the powder of the ſtone was mixed with equal parts of carbonated ſoda, and once more ſubjected to red-heat for half an hour in a ſilver-crucible. The mixture returned from the fire in the form of a moderately coaleſced powder. I diluted it with water, and ſuper-ſaturated it with muriatic acid; which diſſolved the whole of it without leaving any obſervable reſidue. But when the ſolution had been put in a ſand-heat to evaporate, it formed a thick gelatinous coagulum; and after digeſting it for ſome time, it was filtered. The collected *ſiliceous earth*, waſhed and ignited, weighed 105½ grains.

c) The muriatic ſolution, ſaturated with cauſtic lixivium, thickened to a milk-white maſs. By a ſlight exceſs of the alkaline lye, it again diſſolved entirely to a limpid, colourleſs fluid, leaving only a few light-brown, looſe flakes, which, upon edulcoration and ignition, weighed four grains.

d) Theſe four grains of brown reſidue were treated by digeſtion with muriatic acid. *Siliceous earth*, weighing 2½ grains in the ignited ſtate, was then ſeparated. This done, the ſolution was combined with pruſſiat of pot-aſh, and the blue ferruginous precipitate, thereby produced, was collected. Nothing elſe was found in the remaining fluid. The portion of iron, which it contained before, amounted to 1½ grain.

e) The alkaline ſolution (c) was ſaturated to exceſs with
phuric acid, and then combined, in a boiling heat, with
bonated ſoda, to precipitate its earthy contents. The
th, thus obtained, was lixiviated and dried; and after-
rds depurated by means of diſtilled vinegar and ammo-
ac. Upon deſiccation, it weighed 122 grains; but upon
ition, only 72. It was found to be pure *aluminous earth*;
r, when re-diſſolved in ſulphuric acid, and cryſtallized
th an adequate proportion of acetated pot-aſh, it afforded
ly ſulphat of alumine.

Wherefore, the *tranſparent* variety of the *Chineſe agal-*
atolite, calculated for *an hundred* parts, contains:

Silex	*b*)	52¾	
—	*d*)	1¼	
		54	54
Alumine	*e*)		36
Oxyd of iron	*d*)		0,75
Water	*a*)		5,50
			96,25

B.

Opake Chineſe Agalmatolite.

This variety of agalmatolite is reddiſh-white, fleſh-red, and of variouſly coloured veins. Its fracture is dull, and leſs diſtinctly ſplintery. It is opake, or only very little tranſparent on the edges; very ſoft; and feels very greaſy. The ſpecific gravity of it is 2,785.

a) *Two hundred* grains of it, finely ſcraped off from the maſs, ſuſtained a loſs of 20 grains by ignition. Its original reddiſh-white colour was by this proceſs changed to a grey.

b) This ignited powder was a ſecond time expoſed to red-heat for half an hour, in a ſilver-cruible, with its own quantity of deſiccated mild ſoda; which cauſed it to conglutinate but moderately. The mixture, previouſly drenched with water, was combined with an over-proportion of muriatic acid, and the ſolution evaporated to a jelly.— When this had again been diluted with ſufficient water, it depoſited *ſiliceous earth*, amounting to 122 grains, when collected on the filtering paper, and ſubſequently lixiviated and ignited.

c) The muriatic ſolution was afterwards decompoſed by carbonated pot-aſh, and the thorough ſeparation of the precipitating earth was promoted by boiling. The precipitate, which ſubſided in a highly ſwelled ſtate, was lixiviated, and while yet moiſt, brought into a warmed alkaline cauſtic lye; in which it diſſolved in an inſtant, and left only a ſlight browniſh reſidue.

d) Muriatic acid entirely diſſolved this reſidue. By combination with Pruſſian alkali, Pruſſian blue fell down, the

olved again by a ſlight exceſs of the ſolvent. The alum
btained, (*d*), was then added to it, and the whole
itated afreſh by carbonat of pot-aſh, aſſiſted by a boil-
eat. When afterwards edulcorated, dried, purified by
s of vinegar and ammoniac, and finally heated to red-
the precipitated alumine weighed 50 grains.

I then poured ſulphuric acid upon it, and inſpiſſated
ixture on a ſand-bath. The turbidneſs of the fluid,
ing again diſſolved in water, was cauſed by the tender
us earth, which then ſeparated, and conſiſted of two
s after ignition. This being ſubtracted, the quantity of
inous earth (*e*) is reduced to 48 grains; which now, by
ination with acetite of pot-aſh, and cryſtallization,
inued to the end to ſhoot into alum only.

follows, from this decompoſition of the opake variety
he *Chineſe agalmatolite*, that its conſtituent parts give in
undred;

Silex . . .	*b*) .	61	. . . 62
——	*f*) .	1	
Alumine . .	*f*) .		 24
Lime . . .	*d*) .		 1
Oxyd of iron .	*d*) .		 0,50
Water . . .	*a*) .		 10
			97,50

everal examples have ſhewn, that, in the ſyſtematical
ngement of foſſils, the light of chemiſtry ſhould be
guide; and I think the preſent analyſis furniſhes one of
moſt conſpicuous proofs of that point. The three foſ-
, which were the ſubject of this and the two preced-

ing eſſays, have to this day been conſidered merely as varieties of *ſteatites:* and yet, how materially do they differ in their conſtituent parts, conſidering that the ſemi-indurated ſteatites (*Speckſtein*), from *Bareuth*, contains, beſides its portion of *ſilex*, merely *magneſia*; that the ſteatites (*Seifenſtein*), from *Cornwall*, is compoſed of *magneſia* and *alumine*; and that the *Chineſe* ſteatites (*Bildſtein*, *agalmatolite*) contains alſo *alumine*, but not the leaſt trace of *magneſia*. This laſt, which muſt now be removed from the genus of magneſia, and added to that of alumine, ſeems to be properly placed along with lithomarga (*Steinmark*).

Among the other ſtones, alſo manufactured by the Chineſe into figures, or little ſtatues, I have likewiſe met with a white, pure, very finely grained *marble*; which, by bare inſpection, is ſufficiently diſtinguiſhed from the Chineſe agalmatolite here treated of.

LVI.

ADDITION TO THE CHEMICAL EXAMINATION OF *LEPIDOLITE*[*].

SINCE the analyſis of *Leucite*, deſcribed in the earlier part of this work, has evidently proved that it contains the *vegetable alkali* as one of its eſſential conſtituent parts; it was to be expected that this alkaline ſubſtance might likewiſe be found in the mixture of various other ſpecies of ſtones and earths. The firſt confirmation of this conjecture has been afforded to me by the *Lepidolite*.

In the examination of this ſtone, here quoted, the loſs of weight in the ſum of its conſtituent parts, which I could not then farther account for, amounted to 6½ *per cent.*[†] As I ſuſpected that this loſs might ariſe from the vegetable alkali, which at that time was not yet known as a co-conſtituent part of foſſils, I reſolved to undertake a ſecond analyſis of lepidolite.

A.

I reduced, by grinding, 250 parts of the *amethyſtine red lepidolite* to as fine a powder as the hardneſs and lubricity of its ſcaly aggregate particles would allow, and digeſted it with a large quantity of muriatic acid, in a temperature raiſed at intervals to the point of ebullition. The remaining powder of the ſtone, when ſeparated from the muriatic ſolution and waſhed, was deſiccated and ignited. It ſtill appeared, as before, in the form of white, very delicate ſhining ſcales, and weighed 210 grains. Treated with the blowpipe, it fuſed, nearly as eaſily as lepidolite in the rough ſtate, to a ſmooth globule.

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[*] *Eſſay XIX. page 238.*

[†] See *Eſſay XXXII. page* 355 ſeq.

b) This circumſtance making it evident that the muriatic acid had effected only an incomplete decompoſition, I reduced again the remaining powder, by long continued trituration, to the moſt comminuted ſtate poſſible, and boiled it once more with a freſh quantity of muriatic acid. The reſidue ſeparated by filtration ſhewed now no farther diſpoſition to melt, and ſeemed to conſiſt of mere ſiliceous earth.

c) The muriatic ſolutions (*a*) and (*b*) were then evaporated to dryneſs, in a ſand-heat; the ſaline maſs remaining was pulverized, covered with alkohol, and placed in a warm temperature. A conſiderable ſediment ſettled to the bottom; which, after the ſpirituous ſolution had been poured off, was diſſolved in water, combined with ſome drops of ammoniac, and filtered. It then left behind it a browniſh ſlime, conſiſting of alumine, ſilex, and oxyd of mangaueſe.

d) I next evaporated the clear ſolution that had paſſed the filter. It left behind a ſaline pellicle, conſiſting of ſmall cubes; which, after gentle ignition, in order to drive off the ſmall portion of muriated ammoniac exiſting in it, weighed 16½ grains. This ſalt was muriated pot-aſh. Diſſolved in a little water, and combined with a ſolution of pure tartareous acid, it formed acidulous tartrite of pot-aſh,

(cream

of tartar), which by combuſtion yielded carbonat of
1.

w, ſince in 16½ grains of muriated pot-aſh are con-
10 grains of pot-aſh free from water and carbonic
there remain 4 grains of this laſt to be reckoned as
tuent parts in 100 of lepidolite.

B.

Two hundred and fifty grains of powdered lepidolite
expoſed to a red-heat, during two hours, in a ſilver-
le, previouſly mixed with the ſame quantity of very
carbonated ſoda, that had effloreſced in the air. This
re came out of the fire a compactly united maſs, of an
rm, lively brick-red. It was pulverized, and ſuper-
ted with dilute muriatic acid, and kept in digeſtion
e red colour had totally vaniſhed. The *ſiliceous earth*
ubſided from this ſolution was afterwards ſeparated by
s of the filter.

The muriatic ſolution was then evaporated to dry-
the ſaline maſs was extracted, by alkohol, in a low
the ſediment, left undiſſolved by this laſt, was re-
ved in water, then combined with a little ammoniac,
ed, and again evaporated to a dry ſalt.

The dry ſalt, thus obtained, was again diſſolved in
, and, in combination with liquid acid of tartar, ex-
to a warm temperature. At the beginning, the mix-
continued clear; but, gradually, it depoſited minute
lline grains, which, after lixiviation and drying,
hed 12½ grains. They conſiſted of *regenerated tartar*,
which carbonated pot-aſh was produced by com-
on.

d) I now returned to the precipitate, ſeparated by means of ammoniac (*b*). This I diſſolved in dilute ſulphuric acid; and, after having added to this ſolution the ſpirituous ſolution of the muriated alumine (*b*), as well as the muriatic ſolution from which the regenerated tartar had been ſeparated, I ſubjected the whole for ſome time to digeſtion; and finally freed it, by filtration, from the remaining browniſh, muddy depoſite. This ſolution, when farther evaporated, without any addition of acetated vegetable alkali, ſhot into regular cryſtals of alum, amounting to 185 grains. The remainder of it, ſtill farther evaporated, congealed to a ſhapeleſs ſaline maſs.

Thus, by the experiment B, the preſence of the alkaline ſaline conſtituent part in lepidolite has received an additional proof: for, theſe 250 grains of this foſſil yielded as much pot-aſh as was neceſſary to the production of the 12¼ grains of regenerated tartar, mentioned at (*c*), and likewiſe the quantity entering into the 185 grains of the cryſtallized alum here obtained.

However, the quantity of vegetable alkali naturally contained in lepidolite is more accurately ſhewn by the experiment A; according to which, as mentioned in its place (A. *d*), there muſt be added to its other conſtituent parts 4 *per cent.* of pot-aſh.

Hundred parts of *Lepidolite*, therefore, contain:

Silex	54,50
Alumine	38,25
Pot-aſh	4
Oxyds of mangane ſe and *iron* . .	0,75
	97,50
Loſs, partly conſiſting of water	2,50
	100

In my firſt analyſis I noticed my ſurpriſe, that, in thi very fuſible ſtone, beſides the ſilex and alumine, no cor ſtituent part could be found to promote fuſion, except th very trifling portion of the oxyds of mangaueſe and iron.

Yet I do not venture to affirm, unconditionally, that th fuſibility of *lepidolite* is owing to this alkaline ingredie now diſcovered in it; becauſe the *leucite*, whoſe earth parts are likewiſe ſilex and alumine, as well as lepidolit is, in fact, infuſible, notwithſtanding that it contains th alkaline ingredient in five times the quantity of that lepidolite.

LVII.

CHEMICAL EXAMINATION OF URANITE.

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*FIRST SECTION**.

1.) THE ancient philoſophers, who conſidered our globe as the center of the material univerſe; and the ſun, on the contrary, merely as a planet deſtined, like the others, to a periodical circumvolution round the earth, flattered themſelves that they had diſcovered a great myſtery of Nature, in the agreement of the *ſeven celeſtial bodies*, which they aſſumed for planets, with the *ſeven metals* known in thoſe times. In conſequence of the varions hypotheſes which they founded on this ſuppoſed myſtery, they allotted to each metal a certain planet, by whoſe aſtral effluvia its generation and maturation were to be promoted. In like manner, they took from theſe planets their names and ſymbols, to deſignate the metals ſubordinated to them. But as the above number of metals has long ſince been increaſed by later reſearches; and as the diſcovery of new planets has not kept pace with that of metals, the metals newly found out have been deprived of the honour of receiving their names from planets, like the older ores. They, therefore, muſt be ſatisfied with the name given them accidentally, and, in moſt inſtances, by the common miner.

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* Read in the Royal Academy of Sciences, at Berlin. See *Memoire Chimique et Mineralogique ſur l'Urane*, in the *Memoires de l'Academie Royal des Sciences*, &c. Août, 1786, juſqu'à la fin de 1787. Berlin, 1792.

Of late, *ſeventeen* metallic ſubſtances have been acknowledged as diſtinct metals, each of a nature peculiar to itſelf. The deſign of this eſſay is to add one to that number, the chemical properties of which will be explained in the ſequel*.

2.) The particular foſſil, by the decompoſition of which I have diſcovered this new metallic ſubſtance, is the black, or *pitch-blende* (*pſeudo-galena* of many) as it has been hitherto called. In the mean time, I ſhall continue to uſe that appellation, till, in the progreſs of this eſſay, the neceſſity of giving it a new name will be conſpicuous. This foſſil is found at *Joachimsthal* in Bohemia, and at *Johann Georgenſtadt*, in the metalliferous mountains of Saxony.

Only a few writers appear to have been formerly acquainted with this mineral. *Wallerius* and *Brünich* mention, indeed, under the head Argentiferous Ores of Zinc, the *pitch-blende*, and a black *pitch-ore* (*Pecherz*); but it does not appear that they meant by it, or even have known the above foſſil from *Joachimsthal* and *Johann-Georgenſtadt*. *Werner*, to whom its fracture, hardneſs, and gravity, ſufficiently indicated that it could not be a blende, has transferred it from the claſs of zinc-ores to that of the ores of iron, calling it *Eiſen-pecherz*; though only *ad interim*, until its proper place ſhould be aſcertained by chemical analyſis. A ſubſequent conjecture of his, that this foſſil might, perhaps, contain the metallic radical of *tungſten*, or *wolfram*, was thought to be ſupported by actual experiments made at

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* Even this number (17) of metallic ſubſtances has received an addition, by the *Titanium*, ſo lately diſcovered, as is ſhewn by Eſſay XIV. pages 200 and 210.

Schemnitz[*]. But this pretended fact is contradicted by the reſult of the following examination.

3.) The varieties of this foſſil, that have hitherto occurred, may be divided into two ſorts. The *firſt* of them is found in browniſh-black, maſſive, and, for the moſt part, outwardly flat, reniform pieces. It is reſplendent both externally and internally; wholly opake, and of an imperfect conchoidal fracture. It is brittle, admits of being eaſily comminuted by trituration, and affords then a black powder, tending to the greeniſh. Its ſpecific gravity, upon an average, is 7,500.

To this ſort belong, in particular, the pitch-blendes dug at *Joachimsthal*, in the mines, or galleries; *Sächsischer Edelleutstolln, and Hohe Tanne*; where they are accompanied by brown-red ponderous ſpar.

The *ſecond variety*, to which belongs the greateſt part of pitch-blende that occurs at *Johann-Georgenstadt*, is greyiſh black, and exhibits various degradations, from the glittering to the dull or dim. At that place it is obtained in the mine *Georg Wagsfort*, in larger or ſmaller maſſes, between ſtrata of ſchiſtoſe mica (*Glimmerſchiefer*); which is nearly in a ſtate of decay. It is uſually accompanied by a metallic earth (oxyd), of a yellow, reddiſh, and light-brown colour; and, beſides, alſo frequently by the *green mica*, as it is called, cryſtallized in ſmall quadrangular tables. Sometimes it is obſerved to be inveſted by compact galena (*Bleyſchweif*), or having this latter diſſeminated in its ſubſtance in delicate veins and points. It has alſo been met with there in the mine *Neujahrsmaaſſen*, between alternate ſtrata of the fibrous brown iron-ſtone[†].

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[*] See *Bergmannisches Journal*. 1789. Vol. I. page 612.

[†] A more ample deſcription of its external properties has been given by *Karſten*, in the 4th vol. of the *Beobacht. u. Entdeck. a. d. Naturkunde*. Berlin, 1792, page 178.

4.) When pitch-blende is tried by itſelf, before the blow-pe, it undergoes no alteration, and is perfectly infuſible. mixed with ſoda, or borax, and placed in the ſame ſitua-on, it is converted into a grey, cloudy button, reſembling oriæ. But with a neutral phoſphat it produces a clear, green obule. If in theſe trials ſome minute metallic grains er appear, they proceed from the lead interſperſed in the ſſil.

5. *a*) I expoſed *half an ounce* of triturated pitch-blende a ſtrong red-heat, in a coated glaſs-retort. After cooling, I und that it had loſt ſeven grains. A ſmall portion of lphuric acid has alſo paſſed over, and in the neck of the etort a little ſulphur was obſerved to be ſublimed.

b) Another equal quantity of pitch-blende was roaſted in pen fire, that is, on a teſt under the muffle, until all its ulphur had volatilized. By this management it loſt 20 rains. Upon this I kept it one hour longer in ignition, nd obſerved that its weight had again increaſed eight rains.

6.) To examine the relations of pitch-blende to the *fixed lkalis* in the *dry way*, I triturated ½ ounce of it with one unce of carbonated pot-aſh, and urged the fire to the fu-on of the mixture in the crucible. The maſs poured out f the veſſel was black-grey, compact, hard, and of a lamel-r fracture. When ground, boiled with water, and ltered, the powder of the foſſil remained on the paper with s former black colour, and alſo nearly with its original eight. The colourleſs fluid had merely an alkaline taſte, cepting only a ſlight indication of alkaline ſulphuret (*liver ſulphur*); and when ſaturated with nitric acid, it epoſited ſome flocculi of ſiliceous earth, weighing four ains.

By this inſolubility of pitch-blende, in melting pot-aſh, it was decided that it in no way belonged to the foſſils which contain tungſten, or wolfram.

7.) I now proceeded to examine its habitudes with *acids.*

Dilute ſulphuric acid was incapable of effecting a true ſolution; it only extracted from it a faint greeniſh tincture. Even *concentrated ſulphuric acid* did not entirely diſſolve this foſſil: for, after ½ ounce of pitch-blende had been digeſted with one ounce of that acid, in a retort, the liquor being then again diſtilled off to dryneſs, and the reſidue ſoftened with water, and filtered, its undiſſolved part ſtill weighed three drachms: and likewiſe the black colour which it ſtill preſerved ſhewed that no perfect ſolution had taken place. The fluid that had paſſed over was ſulphureous acid; and the ſolution filtered off from the reſidue had a green colour.

8). *Nitric acid*, on the contrary, produced a more complete decompoſition of that foſſil.

a) *Half an ounce* of the greyiſh-black, dull pitch-blende was digeſted, in a low-heat, with moderately ſtrong nitric acid. It was attacked by the acid with an evolution of red nitrous vapours. I affuſed, by degrees, more of the acid, till the diſappearance of the black colour of the foſſil ſhewed that its decompoſition was accompliſhed. The ſolution, when again diluted with water, was of a bright wine-yellow, variegated with the greeniſh. It left on the paper a white-grey reſidue, weighing 16 grains upon deſiccation. This took fire, when heated in an earthen pot, and burned with a ſulphureous flame; loſing thereby 5½ grains. The remaining 10½ grains conſiſted of ſilex; from which nitro-muriatic acid ſtill extracted ſome portion of iron.

b) One *half ounce* of the *blacker ſort* of pitch-blende, treated in the ſame manner with nitric acid, coagulated, upon ſolution, to a bright-green gelatinous conſiſtence, in which ſome light grey-yellow particles lay diſperſed. By dilution with water, and filtration, it left 26 grains of a reddiſh-grey reſidue, 6 grains of which were ſulphur, and the remainder an earthy matter, impregnated with iron.

c) When no pure, compact lumps can be had, the pitch-blende, which is ſtill embodied with its matrix, may alſo be employed for extraction with nitric acid. *Twenty-four* ounces of moderately ſtrong nitric acid, affuſed upon 8 ounces of fragments of this impure pitch-blende, previouſly pulverized, attacked it with vehemence; the mixture became hot, and emitted red vapours. After digeſtion for ſome time, I diluted the ſolution with water, and filtered it. The *gangue*, or matrix of the ſhiſtoſe mica kind, exiſting in the foſſil, remained behind as a light-brown mud; which, after waſhing and deſiccation, weighed 4½ ounces, but loſt one drachm more by burning off the ſulphur which it contained. I concentrated the greeniſh-yellow ſolution, by diſtillation, from a retort; by which management nitrat of lead ſeparated, in white glanular cryſtals, amounting to 50 grains.

g) By *muriatic acid* only an incomplete ſolution was produced.

But if this acid be mixed with one third part of the nitric, the *nitro-muriatic acid* ariſing from this combination effects a perfect ſolution.

Half an ounce of pitch-blende, mixed with two ounces of aqua regia, became hot, and was violently attacked by this ſolvent; at the ſame time that the mixture ſtrongly effer-

veſced

veſced, and the ſolution was almoſt entirely effected for the greateſt part. When it had digeſted a while, it was diluted with water, and paſſed through the filter. Its reſidue weighed 13 grains; which, after the combuſtion of the ſulphur, left nine grains of a ſiliceous matrix. The ſolution depoſited muriat of lead, while cooling, in minute, white, needle-ſhaped cryſtals, which, by reduction, yielded a reguline bead of lead, of ¼ grain. After ſome time, there appeared in the ſolution ſome beautiful, large, bright, greeniſh-yellow cryſtals, in rhomboidal ſix-ſided tables.

10.) Endeavouring to become more accurately acquainted with the metallic principle which is the chief ingredient in pitch-blende, as well as with its chemical relations to other ſubſtances, I performed various experiments with the nitric and nitro-muriatic ſolutions before mentioned.

At firſt I attempted to find whether a *reduction* of it would take place in the *humid way*. With this view, I filled two glaſſes with thoſe ſolutions, immerſing in the one ſome poliſhed iron, and in the other a thin ſtick of zinc. But in neither caſe was any thing precipitated.

11.) Pruſſiat of pot-aſh threw down, from both theſe ſolutions, a *deep-brown-red* precipitate, reſembling red ſulphurated oxyd of antimony (*Kerme's mineral.*). This phenomenon is one of the moſt characteriſtic properties, by which this metallic ſubſtance is diſtinguiſhed. It is true, copper likewiſe falls down, of a brown colour, if precipitated from acid menſtrua by means of Pruſſian alkali; but then it appears rather more in the form of flocculi, of a woolly coheſion: whereas the former, on its precipitation, directly ſpreads, or diffuſes itſelf through the whole volume of the fluid. Still more does the brown-red precipitate, obtained by precipitating the oxyd of molybdena from its muriatic ſolution, by means of Pruſſian alkali, reſemble that mentioned above. However, beſides that the colour of this laſt is brighter, theſe two metallic ſubſtances are, in every other reſpect, ſo different, that they cannot eaſily be miſtaken for each other.

If the pitch-blende, as is moſtly the caſe, be accidentally accompanied by a portion of iron, the precipitate appears, at firſt, of a dirty black, but, after the ſeparation of this, its colour is a purer brown.

12.) *Sulphuret of ammoniac* precipitates the metallic ſubſtance of pitch-blende, diſſolved in acids, of a *brown-yellow* colour; in which caſe, the mixture is uſually covered by a white-grey pellicle of a metallic luſtre.

13.) By *tincture of galls*, or gallic acid, added to exceſs, only a ſlight quantity of a blackiſh precipitate is produced. But if the predominant part of the acid be neutralized by an alkali, a copious precipitation of a *chocolate-brown* enſues.

14.) All *alkalis* throw down the metallic portion from the acid ſolutions of pitch-blende, of a *yellow colour*. This affords another character peculiar to that metallic ſubſtance. The ſhades, or degradations of that yellow colour, are various, according to the degrees of purity of the foſſil, and, likewiſe, according to the nature of the alkaline ſalt employed in the proceſs.

The fixed alkalis promote the precipitation, in the moſt complete manner, if they are uſed in their cauſtic, or pure ſtate. The precipitate is then commonly lemon-yellow; but it inclines more to the white, if carbonated alkali is employed as a precipitant.

15.) If

15.) If more carbonated alkali be added than is required to ſaturate the acid, part of the metallic oxyd will be re-diſſolved; but it falls again down, of a lemon-yellow, by ſaturating the exceſſive portion of the alkali. A ſimilar re-diſſolution, in carbonated fixed alkali, happens, when the yellow oxyd, recently precipitated and waſhed, while yet moiſt, is mixed with deliqueſced pot-aſh, and digeſted in a boiling heat. If, to the ſaffron-yellow ſolution, after ſeparation of the undiſſolved reſidue, nitric acid is added, it throws down the diſſolved part of a pale yellow colour.

On repeating this experiment with cauſtic lixivium, the colour of the metallic oxyd changed to a dark-brown. But this lixivium, being afterwards examined, was found to contain nothing of that oxyd. This circumſtance ſerves to prove that it is not the alkali, but the carbonic acid combined with it, that contributes to effect the ſolution before noticed.

16.) Somewhat different was the colour of the precipitate which I have obtained from the greeniſh nitric ſolution of the blacker variety of pitch-blende (8. *b.*), by means of cauſtic ſoda; for this inclined from the yellow to the green. This is not owing to a latent portion of copper in the foſſil; as the precipitate gives neither colour nor taſte to cauſtic ammoniac poured upon it.

17.) This yellow metallic oxyd readily diſſolves in acids.

When treated with dilute *ſulphuric acid*, gently warmed, it was ſoon diſſolved, leaving only the portion of lead which ſtill remained in it. The ſolution, duly evaporated, afforded a lemon-yellow metallic ſulphat, cryſtallized in ſmall accumulated columns.

18.) The ſolution of the yellow metallic oxyd in weakned *nitric acid*, and made to cryſtallize by evaporation, at firſt depoſited a ſmall quantity of nitrat of lead, and, afterwards, beautiful, clear, oblong, hexagonal tables, of a pleaſing, light-greeniſh colour; ſome of which were ½ of an inch long, and ¼ of an inch broad. To preſerve theſe cryſtals in their original perfection, they muſt be kept in a cloſed veſſel, as they ſeem liable to ſome decay by the acceſs of air.

19.) The ſolution of this metallic oxyd, prepared by *muriatic acid*, evaporated to the point of cryſtallization, and left ſtanding in the cold, at firſt yielded ſome muriated lead, in fine needles; but, after this, it ſhot into yellowiſh-green cryſtals, the fundamental figure of which appears to be the rhomboidal, or oblique quadrangular table.

20.) By diſtilled *vinegar*, ſtrengthened by freezing, this metallic calx was diſſolved, with the aid of digeſtion. After gentle evaporation, this ſolution afforded fine, clear, topaz-yellow cryſtals, in regular, four-ſided, thin columns, with tetrahedral pointed terminations, ſome of them one inch long. When I ſubjected ſome of theſe cryſtals to ignition, beginning with a low heat, the metallic oxyd left, after the expulſion of the acetic acid, preſerved the ſame figure, for the moſt part, which the cryſtals had originally poſſeſſed.

21.) *Phoſphoric acid*, likewiſe, is a ſolvent of the precipitate obtained from pitch-blende. But this ſolution does not long continue clear; the phoſphated metallic oxyd falling down, by degrees, in yellow-white, amorphous flocculi, of difficult ſolution in water. A ſimilar precipitate alſo ariſes on pouring phoſphoric acid into the acetic ſolution of this foſſil.

22.) I introduced a mixture of one part of pitch-blende with three of nitre, by ſucceſſive portions, into a red-hot crucible. The maſs foamed much; but only a weak detonation was obſervable. I kept it in ignition for half an hour, after which I ſet it aſide to cool. It was of a chocolate-brown; and when this maſs, liquified with water, had been filtered, the powder of the foſſil left on the paper remained of the ſame colour. The colourleſs lixivium contained ſtill ſome undecompoſed nitre; and acids cauſed it to depoſite a whitiſh precipitate, which for the moſt part conſiſted of ſilex.

23.) After theſe reſearches, I made ſome experiments relative to the proceſs of *reduction.*—When the yellow metallic oxyd was tried upon charcoal before the blow-pipe, it exhibited the ſame phenomena as were mentioned of the crude pitch-blende, (4.); excepting that it acquired a browniſh-grey colour by ignition; and that the browniſh colour of the globule produced, on its treatment with ſoda and borax, was purer and clearer than that from the rough foſſil: in the ſame manner as the colour of the green globule ariſing from its mixture with an alkaline phoſphat, in the like proceſs, was more pure and clear.

24.) The trials made by fuſion in the crucible gave all exactly ſuch reſults, as thoſe previous ſmall trials upon charcoal would allow me to expect.

a) *One* drachm of *rough pitch-blende*, mixed with 1½ drachm of calcined borax, together with ſome charcoal-duſt, and covered with muriat of ſoda; and

b) An equal quantity of rough pitch-blende, mingled with two parts of black flux, and a little muriat of ſoda, where melted, each ſeparately, in the wind-furnace with a ſtrong fire. In both caſes the foſſil was converted into a black-grey, dim ſcoria, without any trace of reduction: only that ſome metallic grains of lead appeared, originating from the particles of that metal diſſeminated in the rough foſſil.

25.) In the following experiments I employed the *pure yellow precipitate* before mentioned.

a) *One* drachm of it was mixed with two drachms of black flux, and inſerted in a charcoal-crucible;

b) Another drachm was mingled with twice its weight of calcined borax, and likewiſe put in a crucible made of charcoal; and

c) A third drachm was mixed with 10 grains of charcoal-duſt, 20 grains of calcined borax, and two drachms of powdered white glaſs.

Theſe mixtures, the crucibles being firſt luted, were expoſed for one hour and a half to the ſtrongeſt heat of the melting furnace.

The product, which in all three crucibles was nearly the ſame, conſiſted of a black vitreous ſcoria, but exhibited no indication of any metallic button.

26.) Being thus convinced, that the reduction of this metallic oxyd, which I had in view, was not to be accompliſhed by means of ſaline and vitrifying ſubſtances, I reſolved to treat it merely with combuſtible bodies, after the manner of the aſſays of mangancſe. For this purpoſe, I triturated 120 grains of the yellow metallic oxyd to a paſte, with linſeed-oil, and cauſed the oil gently to burn on a

teſt.

teſt. There remained 85 grains of a heavy black powder behind; which I expoſed, in a well ſecured charcoal-crucible, to the medium heat of the procelain-furnace.

At the ſame time, another crucible, containing pure oxyd of *manganeſe*, and prepared in the ſame manner, was expoſed to the ſame fire.

When both theſe crucibles were brought back from the furnace, I found, that, in the *ſecond*, the reduction of manganeſe to the reguline, or metallic ſtate, had been moſt perfectly accompliſhed. But in the *firſt* crucible I found the oxyd, obtained from pitch-blende, in the form of a heavy and only looſely coherent maſs; which by friction between the fingers could be divided into a fine black-brown duſt, yet poſſeſſed of a metallic luſtre.

In pouring nitric acid upon a part of that duſt, the ſolution went on with pretty conſiderable energy; the mixture growing hot, and giving out a quantity of red nitrous fumes. By this phenomenon, I was perſuaded, that the oxyd had in ſome manner been revived to the metallic ſtate, although not run into one maſs; and, hence, that this metallic ſubſtance is more refractory than even manganeſe.

27.) To experience, whether this oxyd of pitch-blende, thus far metallized, would not perhaps prove more fuſible, I put the remaining portion in a charcoal-crucible; covering it with half its quantity of calcined borax, and the remaining ſpace of the veſſel with pulverized charcoal. The outer crucible of baked clay, into which the former was inſerted, was then well luted, and expoſed to the ſtrongeſt heat of the porcelain-furnace. My expectation, as I found by the reſult, was not totally diſappointed; for I now obtained a coherent maſs, conſiſting of conglutinated extremely minute metallic grains, whoſe aggregation, however, was not compact, but finely porous, and like froth. The colour of that metallic maſs was outwardly dark-grey, but inclining on the ſtreak to the browniſh. Its metallic luſtre, for want of perfect denſity, was but moderate, and the coheſion of its integrant particles only ſlight. Its ſpecific gravity, 6,440.

No alteration was produced, when ſmall portions of that regulus were ignited upon charcoal with the aſſiſtance of the blow-pipe. On fuſing it with fuſible phoſphoric ſalt, the globule, while melting, was coated with a dull, ſilvery white pellicle, formed by cohering, exceedingly fine metallic globules. On continuing the fuſion, this metallic cruſt entered deeply into the body of the globule, which at laſt acquired the appearance of a dim, grey-green, porous ſcoria.

28.) With the view of attempting an artificial mineralization by ſulphur, I mixed the yellow oxyd with twice its weight of ſulphur, in a ſmall glaſs-retort, and expelled again from it the greateſt part of the ſulphur, by applying heat. The reſidue combined with the reſt of the ſulphur was a black-brown, compact maſs. But the degree of affinity of this metallic ſubſtance with ſulphur is but low; for, on expoſing again this ſulphurated maſs, in another retort, to the action of fire, the remainder of the ſulphur admitted of being entirely driven out; while the metallic part remained behind in the form of a black, heavy, granular powder.

29.) To inveſtigate what colour this metallic oxyd would give to glaſs-frits, and what effect it would produce on porcelain, when applied to it as an enamel colour, the following experiments were made.

a) *Silex*	2 drachms,
Mild *pot-aſh*	1 drachm,
Yellow metallic oxyd . .	10 grains,

produced a clear, light-brown glaſs.

b) *Silex*	2 drachms,
Mild *ſoda*	1 drachm,
Yellow metallic oxyd . .	10 grains,

yielded an opake, black-grey glaſs.

c) *Silex*, Burnt *borax*, } of each .	2 drachms,
Yellow metallic oxyd . .	20 grains,

afforded a glaſs perfectly reſembling brown rock-cryſt (*Rauch-topaz*).

d) *Silex*, *Vitreous phoſphoric acid*, prepared from bones, }	2 drachms of eac
Yellow metallic oxyd . .	20 grains,

gave a bright apple-green, opake glaſs, almoſt like chry praſe.

e) *Vitreous phoſphoric acid*, from animal bones . .	2 drachms,
Yellow metallic oxyd . .	10 grains,

produced a clear emerald green glaſs.

Theſe two laſt vitrifications, by degrees, attracted m ture from the atmoſphere.

f) The *yellow metallic oxyd*, gently ignited, mixed a proper flux, and applied to porcelain, and fuſed upo in the enamelling furnace, produced a ſaturated or deep orange-yellow colour.

30.) From the whole of theſe experiments it is manifeſt, that the pitch-blende does not belong either to the ores of zinc, or to thoſe of iron, nor yet to the genus of tungſten or wolfram, and in general to none of the metallic ſubſtances hitherto known; but, on the contrary, that it conſiſts of a *peculiar*, *diſtinct*, *metallic ſubſtance.* Therefore its former denominations, *pitch-blende*, *pitch-iron-ore*, &c. are no longer applicable, and muſt be ſupplied by another more appropriate name.—I have choſen that of *uranite*, *(Uranium)*, as a kind of memorial, that the chemical diſcovery of this new metal happened in the period of the aſtronomical diſcovery of the new planet *Uranus**.

31.) In the pit *Georg Wagsfort*, *at Johann-Georgenſtadt*, the *metal uranium* likewiſe occurs in the form of a metallic oxyd, of an earthy appearance. This is the earthy foſſil, already mentioned at the beginning of this eſſay, which there accompanies the compact uranitic ore under various ſhades of colour, paſſing from the pale ſulphur-yellow into the brick-red, as alſo into the brown-yellow. The light-yellow and reddiſh varieties are the pureſt; ſince, when diſſolved in nitric acid, and treated with Pruſſian alkali, they immediately precipitate of a brown-red colour. The darker varieties, on the other hand, contain more or leſs of iron. This earthy oxyd of uranium has formerly been taken for an ochre of iron. It has likewiſe been conſidered, as the product ariſing from a previous decay of ſhiſtoſe mica, which forms the gangue, containing this foſſil in the mine juſt mentioned.

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* This is called *Georgium ſidus* in England only.—Tranſl.

32.) To this place likewiſe belongs the *green mica*, as it was formerly called, that is alſo dug from the ſame pit. This beautiful foſſil is found in the fiſſures, rifts, and partings of the rock, as well as upon the earthy uranitic oxyd; for the moſt part, in the form of thin quadrilateral tables, ſome of which approach to the cubical figure. Its colour is variable, paſſing from the emerald green to that of the green-finch, to a lemon-yellow, and even to the ſilver-white.—It is alſo found on the *Tannenbaum* at *Eibenſtock*, moſtly upon brown hornſtone-quarz, though but very ſparingly.

33.) It is indeed certain, upon various grounds, that this foſſil is not a true mica. Yet its nature continued to be a matter of queſtion, until *Bergmann*, on analyſing it, thought that he had diſcovered in it muriated copper and argil; and it was upon this authority that *Werner* has given it the name *Chalcolite.* Notwithſtanding this, *Bergmann* ſtill entertained ſome doubt concerning the reſult of his own experiments; eſpecially as he could examine only a very ſmall quantity of it.

34.) But according to my experiments, this green mica, or chalcolite, is a *cryſtallized oxyd of uranium, coloured by copper.* After having procured, with great trouble, and ſacrificing ſeveral ſpecimens, a ſmall quantity of exquiſitely pure cryſtals, I poured upon them nitric acid, which diſſolved them quietly, and entirely in the cold. Into one part of this ſolution I dropped nitrated ſilver; but no turbidneſs enſued, though *Bergmann* aſſerts that he has obtained muriat of ſilver. (Horn-ſilver).

Into another portion of the ſolution of the green cryſtals I introduced a poliſhed ſteel-ſpring, and found that it became incruſted with a coppery coating of metallic luſtre.

The remainder of that ſolution was ſaturated with cauſtic ammoniac. A blueiſh-grey precipitate fell down, and the liquor, likewiſe, aſſumed a blue colour. I then added as much ammoniac, as was neceſſary to diſſolve all the copper contained in that fluid; after which, I decanted the bright blue ſolution from the precipitate; affuſing upon this laſt ſucceſſive freſh portions of ammoniac, until this alkaline fluid was no longer tinged blue. The reſidue, which had been thus freed from copper, I re-diſſolved in nitric acid, dividing the ſolution into three parts. When a poliſhed watch-ſpring had been immerſed in the *firſt*, neither copper, nor any thing elſe was precipitated. By combining the *ſecond* portion with Pruſſian alkali, a brown-red precipitate ſufficiently copious was obtained. From the *third* portion, cauſtic pot-aſh threw down a pure yellow oxyd of uranium.

Copper, however, ſhould not be conſidered as an eſſential conſtituent part of the cryſtallized oxyd of uranium; ſince I have not found the leaſt trace of it in another variety, that had a pure wax-yellow colour.

SECOND SECTION.

ANOTHER more pure variety of compact uranite, of a luſtre almoſt metallic, which I afterwards received from *Joachimsthal*, induced me to repeat its analyſis.

A.

a) *Five hundred* grains of this uranitic ore were powdered, and digeſted in a gentle heat, with nitric acid of a moderate ſtrength. The quantity of the acid employed, not being ſufficient to effect a total ſolution, the mixture appeared like a fluid, rendered turbid by a fine brick-red mud; but which diſappeared on the addition of another ſmall portion of nitric acid. The ſolution became clear, while a light-grey flocculent matter ſeparated, and was of a greeniſh aſpect. The reſidue collected by filtering weighed

LVIII.

CHEMICAL EXAMINATION

OF TWO NEWLY DISCOVERED

TITANITES.

THE diſcovery of *Titanium*, in the red Hungarian ſhörl[*], and in the ſmall hair-brown cryſtals, from the country about *Paſſau*[†], having ſo much excited the attention of Chemiſts and Mineralogiſts, it was natural to expect, that this new metallic ſubſtance would alſo be found in other places. The event has ſhewn, that this expectation was not ill founded.

The chemical analyſis made at *Paris* by *Vauquelin* and *Hecht*, with a foſſil, diſcovered by *Miché* and *Cordier* at *St. Yrieux*, in the department of *Haute-Vienne*, has ſhewn, that this metallic ſubſtance is likewiſe a native of France[‡].

To this the preſent eſſay affords a new addition, by giving the analyſis of two other *titanites*, but lately diſcovered.

FIRST SECTION.

Titanite from Spain.

I HAD the pleaſure of receiving from the collection of *Baron Racknitz* at *Dreſden*, which is particularly rich in

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[*] See *Eſſay* XIV. page 200.

[†] *Eſſay* XV. page 211.

[‡] *Journal des Mines*. Paris. No. XV. page 10.

niſh minerals, a foſſil whoſe outward characters juſtified
ſuſpicion, that it might be an ore of Titanium.

It occurs at *Cajuelo*, near *Vuitrago*, in the province of
rgos.

The internal colour of it is a light reddiſh-brown, inclin-
; in ſome places to the copper-red; but externally it is
ted with white clay. It ſeems to have the form of a
cahedral column, with a flat ſix-ſided pyramidal termina-
h; but inſtead of the actual point, it has a regular exca-
ion, which reſembles an inverted, hollowed, hexahedral
ramid. In the inſide, that foſſil has a ſtrong ſemi-metal-
luſtre. Its croſs-fracture is very diſtinctly ſtraight la-
llar; and its longitudinal fracture imperfectly and ſmall
choidal. It is very little tranſparent on the edges;
ttle, very hard, and of difficult levigation, by which it
rds a greyiſh-brown powder. The ſpecific gravity of
s = 4,180.

One *hundred* grains of it, finely ground, and mingled with
grains of mild pot-aſh, were brought to fuſion in a crucible.
e melted maſs was of a pearly-grey, which, upon re-diſſo-
on in hot water, depoſited the *oxyd of titanium* of a per-
ly white colour. When this had been filtered off from
colourleſs alkaline fluid, and lixiviated with water, till
waſhings no farther indicated any trace of alkali, it was
ccated, and found to weigh 175 grains.

This titanic oxyd readily diſſolved in muriatic acid, and
precipitated from it of a permanent green, by Pruſſian
li, and of a lively brown-red, by gallic acid; and in
eral, in all its other properties, it agreed with the white
d of titanium, extracted from the red Hungarian ſhörl.

SECOND SECTION.

Titanite from Aſchaffenburg.

WITH the foregoing titanite from Spain another foſſil correſponds, which Prince *Dimitri Gallitzin* has found ſeveral years paſt not far from *Aſchaffenburg*, in the *Speſsart* foreſt, preſerved in his collection as a mineral not yet aſcertained.

Its interior colour is a deep reddiſh-brown; externally it paſſes ſomewhat into the lead-grey, and exhibits ſilver-white ſcales of mica adhering to it. The ſpecimen, here examined, was a rounded priſmatic, and, as it appeared, a four-ſided cryſtal; the alternate angles of whoſe facets ſeemed to be obtuſe, and the ends apparently not yet completely cryſtallized. Its fracture exhibits a ſtrong ſemi-metallic ſplendour. The longitudinal fracture is ſtraight foliated; the croſs fracture, imperfectly conchoidal. It is untranſparent, brittle, and very hard. Its ſpecific gravity was found to be 4,055.

One hundred grains of this titanite were finely powdered, and fuſed with 600 grains of carbonated pot-aſh. The maſs, when fixed by cooling, preſented a greeniſh ſurface, and a pearly grey fracture. Upon pulverization, and ſolution in water, the filtered alkaline liquor was likewiſe greeniſh, but ſoon loſt its colour. The lixiviated and dried *oxyd of titanium* weighed 166 grains. Its white colour had a little of a reddiſh tinge, ariſing, perhaps, from a ſmall portion of mangane ſe; the traces of which were ſhewn by the external greeniſh colour of the melted maſs, as well as afterwards by that of the alkaline liquor.

As for the reſt, the metallic oxyd obtained from this foſſil of *Aſchaffenburg* exhibited in every reſpect the ſame habitudes or relations, as the preceding from *Spain*, or that which had been ſeparated from the *Hungarian* titanite.

LIX.

INATION

ITANITES.

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from Cornwall.

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*known nature**.

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nalen. 1791. vol 1 pages 40 and 103.

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Though I was eaſily convinced of this fact by my own experiments, it ſeemed, on the other hand, very difficult to ſeparate entirely the iron from the titanic oxyd; and, hence, to aſcertain the true proportion of theſe two ingredients to each other. Paſſing over various experiments which I made with this deſign, I will relate only the two following, by which I obtained the oxyd of titanium, freed the moſt from iron.

A.

a) *Two hundred* grains of menachanite, finely powdered, were mixed with ten times their quantity of a lixivium, compoſed of equal parts of cauſtic pot-aſh and water. This mixture, being inpiſſated to dryneſs in a poliſhed iron-pot, lodged in a ſand-bath, was afterwards ignited in open fire. The maſs ran into thick fuſion, and aſſumed in cooling a dirty dark-green colour.

b) By dilution with water, it gave a greeniſh ſolution, from which a dark cinnamon-brown powder ſubſided, which, detained on the filter, edulcorated, and dried, appeared very looſe, and weighed 374 grains.

c) The green alkaline fluid ſoon loſt its colour, and depoſited ſome brown flakes, which upon trial were found to be an impure *oxyd of mangane*ſ*e*, and weighed half a grain. When this liquor had been treated with an over-proportion of muriatic acid, and again neutralized with carbonated potaſh, it afforded a whitiſh precipitate, which afterwards was decompoſed into ſeven grains of ignited *ſilex*, and two grains of *oxyd of titanium*.

d) The 374 grains of brown-powder (*b*) were mixed with ſix ounces of muriat of ammoniac, and ſublimed in a retort.

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and was found to be ſtill contaminated with iron.
n freed from this metal by previous lixiviation with
r, and ſubſequent digeſtion with muriatic acid, it was
grey-white, after a repeated waſhing and drying, and
unted to 168 grains.

This grey-white metallic oxyd, proving inſoluble in
, was fuſed in a crucible with five times its quantity of
nated pot-aſh, and poured out. After congelation,
line maſs preſented a pearly white; was compact, and
coarſe-ſtriated fracture. On triturating, and waſhing
th water, the metallic oxyd was left behind of a per-
white colour. This, when edulcorated and dried,
hed 276 grains, and ſhewed itſelf in every reſpect to be
pletely pure *oxyd of titanium*.

To obtain the iron, I diſſolved in water the ſublimed
t of ammoniac (*d*), mixed the ſolution with the water
oyed for edulcorating the reſidue, which thereby be-
muriated, and then I ſaturated the whole with cauſtic
niac. The brown *oxyd of iron*, thus ſeparated, was
, drenched with linſeed-oil, and heated to redneſs. It
hed 100 grains, and was rapidly and entirely attracted
e magnet.

B.

ffected another complete decompoſition of menachanite
e following ſhorter way.

Two hundred grains of menachanite were prepared for
decompoſition in the ſame manner as explained before
A. *a*, and *b*); and the light-brown powder, thus ob-
d, was ignited for half an hour in a crucible. It now

received a blackiſh chocolate-brown colour, and weighed 260 grains.

b) After having affuſed upon it three ounces of muriatic acid, I evaporated it in a porcelain veſſel to a moderately deſiccated maſs; the colour of which was yellow, like the yolk of eggs, and mixed with orange-yellow. It was then diluted with water, and put on the filter. The filtered liquor contained muriated iron, and the waſhed reſidue exhibited on the paper a fine, heavy powder, of an iſabella-yellow, which, dried in a low-heat, weighed 106 grains.

c) I mixed this with a quintuple portion of carbonated pot-aſh, and brought it into fuſion in a crucible. The maſs, when poured out, and fixed by refrigeration, was of a pearl-grey, with ſome light-browniſh ſpots. Upon triturating, and edulcorating it with water, the titanic oxyd remained behind as a flocculent, yellowiſh-white powder, amounting to 226 grains, when deſiccated in the air.

d) This oxyd readily diſſolved in muriatic acid, and entirely, without leaving any reſidue. However, it was not perfectly free from iron; ſince the precipitate produced from it by the infuſion of galls did not exhibit that deep-yellow-red-colour, which is peculiar to the pure gallated oxyd of titanium. On this account, I cauſed the ſolution to boil upon a ſand-heat; by which management the titanic oxyd ſeparated from the liquor in the form of white gelatinous flocculi. It was then collected on the filter, and lixiviated with water, until this laſt was no longer blackened by gallic acid.

e) The titanic oxyd, again deſiccated, appeared now of a bright yellow colour, and was not attacked by acids in its preſent ſtate. To render it again ſoluble, I ignited, and urged it by heat to fuſion, with five times its quantity of carbonat of pot-aſh. The pearl-grey maſs, then produced, and ſoftened by warm water, depoſited the metallic oxyd of a perfectly white colour, weighing 230 grains, after edulcoration and drying. Muriatic acid readily diſſolved this oxyd, which now, upon trial, appeared to be pure *oxyd of titanium*, abſolutely *free from all iron.*

f) The fluids, that held the muriated iron in ſolution, were combined with cauſtic ammoniac; and the *oxyd of iron* precipitated by that means, when moiſtened with linſeed-oil, and ignited, was found to weigh 102 grains.

With regard to the proportion of titanium to iron in menachanite, it cannot be determined in the direct way. The reaſon of this is, that the weight of the ſeparated oxyd of titanium varies very much, according to the different degrees of ſaturation with oxygen, and perhaps alſo with carbonic acid; and moreover, according to the degree of deſiccation, &c. With greater certainty may the ſtate of the iron contained in menachanite be determined; which ſeemingly agrees with that of *Ethiops martial*, or black oxyd of iron, attractible by the magnet. Allowing this, the conſtituent parts of *Menachanite* in the *hundred* may be aſſumed as follows:

Oxyd of iron, attractible by the magnet .	51
Oxyd of titanium	45,25
Silex	3,50
Oxyd of manganeſe	0,25
	100

C.

In order to become acquainted with the habitudes of menachanite in fire, I ſubjected it to the following experiments.

a) Expoſed in a *charcoal-crucible* to the fire of the porcelain-furnace, it proved infuſible. Its grains were rendered ſomewhat more porous; its black colour had become paler, and its luſtre leſs brilliant. At the ſame time its ſurface was found overlaid with minute grains of iron.

b) But in the *clay-crucible*, the menachanite entered into perfect fuſion, and in this ſtate was imbibed by the pores of the veſſel; the places of which, that had been penetrated by the melted foſſil, were externally brown, but in the fracture black and reſplendent.

SECOND SECTION.

Ferruginous Titanite from Aſchaffenburg.

MENACHANITE is not the only inſtance of a foſſil compoſed of the oxyds of iron and titanium. Beſides that from Cornwall, ſimilar mixtures occur in various countries, differing only in the proportions of their reſpective ingredients. A proof of this is afforded by the following examination of a foſſil, which Prince *Dimitri Gallitzin* has likewiſe found in the *Speſsart* foreſt, near *Aſchaffenburg*, together with the pure titanite deſcribed and examined in the preceding ſection. The ſpecimens given me for the ſake of this enquiry, by that zealous promoter of mineralogical ſcience, are of various ſizes; the largeſt is two inches long, one inch broad, and half an inch high. Moſt of them are free from the *veinſtone*, or matrix; but ſome are embodied in a grey, flat-conchoidal quarz (*Fettquarz*). Their colour is iron-black, accompanied outwardly by a moderate, but inwardly by a ſtronger, metallic luſtre. The foſſil itſelf is compact and opake. Its fracture is uneven, and of a fine grain; its fragments indeterminately angular. It is very brittle, hard, and is only with difficulty ground to a ſubtle powder

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c) The portion of iron, ſuſpended in the muriatic ſolution, was precipitated by cauſtic ammoniac, and, when collected, it was moiſtened with linſeed-oil, and ſubjected to a low red-heat. This *iron* weighed 78 grains, and the whole of it obeyed the magnet.

As, therefore, no other conſtituent part exiſted in the foſſil, I may fairly conſider the remaining part as its *titanic* portion. According to which, an *hundred* parts of the foſſil contain:

Oxyd of iron . .	78
Oxyd of titanium .	22
	100

THIRD SECTION.

Ferruginous Titanite from Ohlápián.

A.

At the works at *Ohlápián*, in *Tranſylvania*, where auriferous ſands are waſhed, there occurs a *titanite* mixed with leſs iron. It conſiſts of compreſſed, or flat, rounded grains, for the moſt part of the ſize of a lentil, in which, now and then, ſlight traces of a deſtroyed cryſtalline form are obſervable. Its colour is greyiſh-black, inclining to the browniſh-red. It is opake; externally of a middling, internally of a brighter, metallic luſtre; of a lamellar texture; very hard, brittle; and reducible, by grinding, to a greyiſh-brown powder. Its ſpecific gravity is 4,445.

If heated alone before the blow-pipe, it ſuffers no ſenſible alteration. Nor does the magnet ſhew any action upon this foſſil, either in the rough ſtate, or roaſted.

This foſſil is one of the mingled heterogeneous parts conſtituting the auriferous ſands at Ohlápián, which conſiſt of very unequal grains, as well with regard to their ſhape or form as to their bulk. Of theſe accumulated ſands, the larger grains conſiſt, for the greateſt part, of this titanic ore.

The middle-ſized grains are partly light-crimſon, partly carmine-red. They are opake, and have half a line, ($\frac{1}{24}$ of an inch) in diameter. They bear great reſemblance to ſpinell, or, on account of their conchoidal fracture, to the ruby, or red ſapphire.

The ſmalleſt of them, which ſeem to be *grains of quarz*, are yellowiſh-white, very tranſparent, or ſemi-pellucid, acute angular, and in their diameter hardly $\frac{1}{120}$ part of an inch wide.

Of this laſt ſize there exiſt alſo many fine black grains in the general maſs, which probably are likewiſe *titanium.*

Theſe, and the granular quarz, conſtitute by far the greateſt part of the whole. The mingled heap, from *one ſixth* to *one fourth* part, conſiſts of the red grains; but the larger titanic grains lie but ſparingly diſtributed among them.

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a) *Two hundred* grains (by weight) of theſe minute titanites, previouſly pulverized, were mixed with a lixivium made of 600 grains of cauſtic pot-aſh in a ſilver veſſel, and after being evaporated to dryneſs, gently ignited for half an hour. This maſs came out of the fire of a verdigris colour, with brown-red ſpeckles. When diffuſed in water, and paſſed through the filter, it left on the paper a looſe, bright, and brown-red powder. The filtered alkaline liquor had at firſt a deep-green colour, but which ſoon diſappeared; and it depoſited *oxyd of manganeſe*, weighing four grains after ignition. When this precipitate had been removed, I ſaturated the fluid with muriatic acid, which threw down a whitiſh precipitate, turning yellow upon deſiccation, and conſiſting of *oxyd of titanium*.

b) This brown-reddiſh powder I boiled in a ſand-heat with muriatic acid, evaporating it afterwards nearly to dryneſs. By this treatment the maſs aſſumed a yellow colour, like the yolk of eggs. It was in the next place diluted with water, and the white *oxyd of titanium*, ſeparating from the fluid, was collected on the filter.

c) This oxyd, being lixiviated and deſiccated, together with the titanic oxyd obtained at (*a*), was mixed and fuſed in a porcelain-veſſel with ſix times their weight of carbonated pot-aſh. This united maſs, when re-diſſolved in hot water, depoſited a very white, pure *oxyd of titanium*, now ſoluble in all acids; which in this ſtate of purity, and after waſhing and exſiccation, amounted to 275 grains.

d) Cauſtic ammoniac precipitated the *oxyd of iron*, that was held in ſolution by the muriatic fluid (*b*). This being collected, waſhed, and expoſed, with ſome linſeed-oil, to a gentle red-heat, was found to weigh 28 grains.

On calculating by the method noticed in treating of menachanite, it appears that an *hundred* parts of this *foſſil from Ohlapian* conſiſt of:

Oxyd of titanium	84
Oxyd of iron	14
Oxyd of manganeſe	2
	100

B.

B.

this difference diſcovered in thoſe three foſſils, with
t to the proportion of their two chief conſtituent
to each other, their claſſification in the mineralogical
is rendered ſomewhat difficult.—If the predominant
tuent parts be aſſumed as the baſis of a mineralogical
gement, the *foſſil from Ohlápián* will take its place as a
s of the titanium genus, under the name of *ſidero-ti-*
n; but the *menachanite*, together with the *foſſil from*
peſtart, would conſtitute a new ſpecies belonging to
nus of iron, and obtain the denomination of *titano-*
n.

conclude: as, beſides in the foſſils here treated of, I
diſcovered in various others, of the genus of iron,
traces of this new metallic ſubſtance (as, for exam-
the ſmall *magnetic iron-grains from Ceylon*, which are
found there in conſiderable quantity, on waſhing the
ed hyacinth, and other ſmall looſe fragments of gems),
neceſſary, that for the future, in the more accurate
nations of the iron ſtones and ores of iron, regard
alſo be had to *titanium*, as one of their poſſible in-
nts.

LX.

CHEMICAL EXAMINATION OF THE *GARNET-SHAPED ORE of Manganeſe.*

IN the granitic rocks of the *Speſsart*, near *Aſchaffenburg*; whoſe chief aggregate parts are coarſe-granular fel-ſpar, moſt frequently of a fleſh-red, grey-quarz, and a little ſilvery-white mica; there likewiſe ſometimes occur, as acceſſary ingredients, ſome black priſmatic ſhörls, but, ſtill ſeldomer, a foſſil, hitherto unknown; the analyſis of which I have made the ſubject of the preſent eſſay, and which, in the mean time, I deſignate by the name of *garnet-ſhaped ore of mangane ſe.*

The merit of its diſcovery belongs to *Prince Dimitri Gallitzin*; and that of the deſcription of its external characters, here ſubjoined, to Mr. *Karſten.*

" The varieties of this foſſil moſt recently collected poſ-
" ſeſs a *deep-hyacinthine red* colour, which, in ſome, changes
" to the *reddiſh, or yellowiſh-brown*; and ſome burſt pieces,
" that appear to have already ſuffered ſome decay, are in-
" wardly ſpotted *greeniſh.*

" Their form of cryſtallization is not quite diſtinct; no
" *perfect cryſtals* having been yet found. But to judge
" from the fragments inſpected, as well as from the caſts,
" (the originals of which exiſt in the cabinet of *Prince*
" *Gallitzin)*, their leading figure ſeems to be a *double eight-*

ſided pyramid, ſharpened off on both ends with four ſurfaces. This pointed termination is *more flat*, and all the angles are *more rhombic*, than in the garnet. Their edges are partly without truncation, and partly in a reverſed order; ſo that two and two joined to each other have their faces formed by the truncation, but the third remains entire. Thoſe cryſtals are in part of a *middling ſize*, in part *ſmall*, and *very ſmall*, all of them *imbedded* in granite.

"Externally they are *finely*, and, as it ſeems, *alternately ſtriated.*

"At the ſame time they are *ſhining*. The ſmalleſt varieties alone, in which the ſtriæ almoſt entirely eſcape obſervation, are ſtrongly reſplendent, of a luſtre between the gloſs of fat and the brilliancy of the diamond.

"Internally, (where the foſſil is undecayed) it is throughout *very reſplendent*, of a fine diamond luſtre.

"Its *fracture* is in *two directions*; namely, thoſe which correſpond with the ſtriæ, *straight-laminated*; but in all other directions, making an angle with the ſtriæ, *ſmall conchoidal.*

"The *fragments* appear to be angular, of an indefinite form.

"In thoſe ſpecimens which I have before me, I do *not* perceive *detached* or *inſulated pieces.*

"The foſſil is alſo *strongly tranſparent*, more or leſs, on the edges.

“ *Semi-indurated*, in a higher degree than pitchſtone;
“ Very *brittle*; and *not* particularly *heavy*.
“ Its *ſpecific gravity*, at a mean ratio, I have found to
“ be 3,600.”

A.

a) Ignited by itſelf upon charcoal, this foſſil is by degrees converted into a round greeniſh-black globule.

b) By borax it is gradually diſſolved into a clear olive-green pearl.

c) Neutral phoſphoric ſalt acts upon it only in a languid and imperfect manner, and forms with it by ſolution a very rifty globule, of a faint amethyſtine tinge. If nitre be projected upon it, while red-hot, the ſalt remaining upon the charcoal, after detonation, acquires ſome deep amethyſt-red ſpots.

B.

a) *Hundred* grains yielded, by grinding to fineneſs, a reddiſh-yellow powder. This was covered with a lye containing 300 grains of carbonated pot-aſh; and when previouſly inſpiſſated to dryneſs, it was ſubjected to red-heat. The ignited deep-green maſs, diffuſed in water and filtered, afforded a lixivium of the ſame colour. By ſaturating it with nitric acid, its green colour was changed to a red. When expoſed to a warm temperature, all its colour diſappeared, and the fluid depoſited brown flocculi, which, collected, weighed 4½ grains.

b) The lixiviated reſidue was of a deep black-brown,
l weighed, upon deſiccation, 141 grains. Nitric acid,
th which it was digeſted, ſhewed by itſelf alone no ſolvent
wer upon it; but attacked it only when I added ſugar to
: mixture. The black-brown colour of the mixture diſ-
peared; and from the ſolution, now become clear, *ſilice-*
earth ſeparated, amounting to 35 grains, upon edulco-
ion and red-heat.

c) To the clear, bright-yellow, nitric ſolution, cauſtic
nmoniac was added to exceſs of ſaturation. A light-
own precipitate enſued. The remaining colourleſs fluid,
luced by evaporation to a ſmaller volume, continued un-
anged, on combining it with carbonated pot-aſh.

d) I re-diſſolved this precipitate (c) in muriatic acid, and
ated the ſolution, firſt with leſs cauſtic pot-aſh than was
uired to neutralize the little predominant portion of un-
nbined acid. Upon this, I added to it a ſolution of 400
ins of tartrite of pot-aſh (*tartarus tartariſatus*), which
duced a copious, ſtraw-yellow precipitate, in fine grains.
ne whole mixture was again evaporated to dryneſs,
n ſtrongly ignited in a porcelain-crucible, and the
ck-brown reſidue was lixiviated with a ſufficient quantity
water.

This reſidue, when dried again, together with the pre-
ling, of 4½ grains (a), was once more ignited. It then
eared in the character of a fine *oxyd of manganeſe*, and
ighed 49 grains.

I digeſted once more this manganeſian oxyd with nitric
l, adding ſucceſſive portions of ſugar, and, laſtly, diluting
mixture with water, and filtering it. On the paper
re remained *oxyd of iron*, which, edulcorated, and heated

to redneſs, weighed 14 grains; and, after a ſecond ignition with wax, was quickly attracted by the magnet. By deducting this, there remain, therefore, 35 grains for the *oxyd of manganeſe*.

f) The water employed to lixiviate the ignited maſs (*d*) exhibited now a colourleſs alkaline ſolution. When fully neutralized with muriatic acid, and treated with carbonat of ſoda, a white, looſe earth was precipitated, which, edulcorated and ignited, weighed 14¼ grains. This earth, diſſolved in ſulphuric acid, and, when made to cryſtalliſe by proper management, afforded, throughout the proceſs, cryſtals of *alum*.

Wherefore, *hundred* parts of this *garnet-ſhaped ore of manganeſe* have yielded:

Oxyd of manganeſe	*e*) . . .	35
Oxyd of iron . .	*e*) . . .	14
Silex	*b*) . . .	35
Alumine . . .	*f*) . . .	14,25
		98,25

ſome ſuperincumbent ſcoriaceous globules; which weighed two grains, and were probably ſome remnants of chloritic earth.

3.) *Cryſtallized grey tin-ſtone*, having ſome white tranſparent ſpots, from St. *Agnes*, in *Cornwall.* The ſpecific gravity of theſe cryſtals is 6,840. *One hundred* grains, treated in the ſame manner, yielded 74 grains of revived tin.

4.) *Stream-tin (Seifenzinnſtein)* from *Ladock*, in *Cornwall. One hundred grains* of this ore, conſiſting of looſe blackiſh grains, and of the ſpecific gravity of 6,560, were reduced in this way to 76 grains of reguline tin.

5.) *Stream-tin*, from *Alternon*, in *Cornwall.*

The colour of this, which muſt be reckoned among the pureſt tin-ores, is in ſome places darker, in others lighter. Of all the tin-ſtones, which I have weighed on the hydroſtatic-balance, I have found the preſent the moſt ponderous; its ſpecific gravity being 6,970.

The reduced, or metallic tin, obtained from *hundred* grains of this ore, weighed 76 grains.

6.) *Wood-tin*, from Cornwall.

This remarkable ſpecies, which till now is only known in ſhivery looſe fragments, or *ratchill* of the miners *(Geſchieben)*, occurs in the waſhing works of tin, in the neighbourhood of St. *Colomb*, *Roach*, and St. *Denis*, in *Cornwall*; but in ſmall quantities only. Uſually the pieces are but ſmall; thoſe that have the ſize of a bean belong to the ſcarcer ones*.

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* A ſpecimen of wood-tin, of the ſcarceſt magnitude, exiſts in the exquiſitely fine collection of *Baron Racknitz*, at *Dreſden.* It is *two* inches long, and *one* broad.

This ore, the only one of its kind, is externally diſtinguiſhed from the common tin-ſtones, chiefly by the total abſence of any cryſtalline form; while, on the other hand, it exhibits its peculiar, bundled or faſcicular fracture. Its external characters have been fully deſcribed by *Werner** and *Karſten*, chiefly†.

I found the ſpecific gravity of wood-tin-ſtone to be 6,450.

One hundred grains of it, reduced in the manner already mentioned, *viz.* ſimply in the charcoal-crucible, gave 73 grains of reguline tin.

By the ſame method, I have ſubjected to the *proceſs* of *reduction* various other tin-ſtones, as well as waſhed and pounded tin-ores, and have conſtantly obtained, in the reſult, from 72 to 77 *per cent* of reguline tin. The ſmall portion of iron, commonly contained in tin-ſtones, uſually ſticks to the ſurface of the reduced tin, in very minute grains; and it is owing to this, that the button of tin is moved when the magnetic needle is approached to this part of its ſurface.

It is worth remarking, that uſually ſmall cavities are formed in the button of revived tin, as it cools and becomes fixed; which ſmall fiſſures are covered by minute lamellæ, that, in colour and brillancy, reſemble poliſhed gold in a very illuſive manner.

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* *Beobach. u. Entdeck. a. d. Naturkunde*, vol. I. Berlin, 1787, page 152.

† *Ibidem*, vol. IV. 1792, page 397.

B.

B.

Habitudes of Tin-ſtone, when expoſed to heat in a crucible made of clay.

1.) *Brown-tin-ſtone* from *Schlackenwalde*, expoſed to a porcelain-fire, in a baked clay-crucible, ran into a clear denſe glaſs, greeniſh-grey in the middle, but of a bright yellow on the ſides, and at top. The ſurface was inveſted with a dull whitiſh cruſt. The interior ſides of the veſſel were glazed of a milk-white, and overlaid with many ſmall groups of light-brown, tender, needle-ſhaped cryſtals. The inner ſurface of the crubible lid, had alſo ſimilar detached cryſtals adhering to it.

2.) *Needle-tin* from *Polgooth*, ſubjected in a clay-crucible to the heat of the porcelain-furnace, likewiſe produced a compact, light-browniſh, tranſparent glaſs; covered on the upper ſurface with a browniſh, dim, and ſhrivelled, or furrowed cruſt.

3.) *Stream-tin* ore from *Alternon*, committed in the ſame manner to the porcelain-furnace, in a crucible of baked clay, yielded a compact light-yellow, and ſtill ſomewhat clearer glaſs, that was found coated by a dull cruſt, of an iſabella-yellow.

SECOND SECTION.

Experiments in the humid way.

THE extreme reſiſtance which tin-ſtone oppoſes to acid menſtrua has hitherto always prevented the complete ſucceſs of its decompoſition in the *humid way*; the reaſon of which

This ore, the only one of [illegible] timate and difficultly
ed from the common tin-[illegible] oxygen. To be diſſolv-
of any cryſtalline form [illegible] als, requires a commen-
bits its peculiar, bundled [illegible] if that proportion be
characters have been [illegible] -ſtone, with *putty* or tin-
ſten, chiefly†. [illegible] tin by ignition with ac-
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I found the ſpeci[illegible] the ſolution cannot take
6,450. [illegible] cauſing this impediment

One hundred grain[illegible]
mentioned, *viz.* [illegible]
grains of reguline [illegible]

By the ſame [illegible]* was the only author,
reduction vario[illegible] ting tin-ſtone in the humid
pounded tin-ore, [illegible] well as other chemiſts†, have
from 72 to 77 [illegible] perfection. However, I en-
of iron, common[illegible] proceſs recommended by him
the ſurface of the [illegible] employed for wood-tin;

muſt be ſought for in the highly intimate and difficultly deſtructible combination of tin with oxygen. To be diſſolved in acids, tin indeed, like other metals, requires a commenſurate proportion of oxygen. But if that proportion be exceeded, as is the caſe with tin-ſtone, with *putty* or *tin-aſhes* (the white, perfect oxyd of tin by ignition with acceſs of air)· with the oxyd of tin corroded by nitric acid, and ſimilar other calces of that metal; the ſolution cannot take place, unleſs the exceſs of oxygen cauſing this impediment be previouſly removed.

A.

Till the preſent period, *Bergmann*[*] was the only author, who has ſhewn a method of analyſing tin-ſtone in the humid way: but unfortunately, I, as well as other chemiſts[†], have ſufficiently experienced its imperfection. However, I entertained a hope, that the proceſs recommended by him would moſt likely ſucceed when employed for wood-tin; on the ground, that of all tin-ſtones, this at leaſt yields in ſome manner to the attack of acids; as I obſerved that 60 grains of it, reduced to an impalpable powder, and ſubjected to vigorous and long continued digeſtion with three ounces of nitro muriatic acid, had loſt five grains of weight.

For this purpoſe, I digeſted 120 grains of finely pulverized *wood-tin*, for ſome time, with *one* ounce of concentrated ſulphuric acid, and the aſſiſtance of a boiling heat. After this, I added by degrees two ounces of muriatic acid, and

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[*] *Opuſcula Phyſica et Chemica.* vol. II. page 437.

[†] *Chemiſche Annalen.* 1786. 2 Band, page 126.

1. *a*) One *hundred* grains of tin-ſtone from *Alternon*, in *Cornwall*, previouſly ground to a ſubtle powder, were mixed in a ſilver-veſſel with a lixivium containing 600 grains of cauſtic pot-aſh. This mixture was evaporated to dryneſs in a ſand heat, and then moderately ignited for half an hour. When the grey-white maſs, thus obtained, had been ſoftened while yet warm, with boiling water, it left on the filter 11 grains of an undiſſolved reſidue.

b) Theſe 11 grains, again ignited with ſix times their weight of cauſtic pot-aſh, and diſſolved in boiling water, left now only 1¼ grain of a fine yellowiſh-grey powder behind.

c) The alkaline ſolution (*a* and *b*), which was in ſome degree colourleſs, was ſaturated with muriatic acid. A brilliant white, tender oxyd of tin was thrown down, giving to the mixture a milky appearance. This precipitate, re-diſſolved by an additional quantity of muriatic acid, was precipitated afreſh by means of carbonated ſoda. When lixiviated and dried in a gentle heat, it acquired the form of bright-yellowiſh, tranſparent lumps, having in their fracture a vitreous luſtre.

d) This precipitate, being finely powdered, ſoon and entirely diſſolved in muriatic acid, aſſiſted by a gentle heat. Into the colourleſs ſolution, previouſly diluted with from two to three parts of water, I put a ſtick of zink; and the oxyd of tin, thus reduced, gathered around it in delicate, dendritic laminæ of a metallic luſtre. Theſe, when collected, waſhed, dried, and fuſed, under a cover of tallow, in a capſule placed upon charcoal, yielded a button of pure metallic tin, weighing 77 grains.

e) The above mentioned reſidue of 1¼ grain, left by the treatment with cauſtic pot-aſh (*b*), afforded with muriatic acid a yellowiſh ſolution; from which, by means of a little piece of zink introduced into it, ½ grain of tin was ſtill depoſited. Pruſſian alkali, added to the remainder of the ſolution, produced a ſmall portion of a light-blue precipitate; of which, after ſubtracting the oxyd of tin now combined with it, hardly ¼ of a grain remained, to be put to the account of the iron contained in the tin-ſtone, here examined.

In theſe experiments, (excepting only a ſlight indication of *ſilex* amounting to about ¾ of a grain), no trace has appeared, either of tungſtenic oxyd, which ſome Mineralogiſts have ſuppoſed to be one of the conſtituent parts of tin-ſtone, nor of any other fixed ſubſtance. Therefore, what is deficient in the ſum, to make up the original weight of the foſſil analyſed, muſt be aſcribed to the loſs of oxygen; and thus the conſtituent parts of *pure tin-ſtone from Alternon* are to each other in the following proportion:

Tin	77,50
Iron	0,25
Silex	0,75
Oxygen	21,50
	100

2.) I repeated the ſame experiment with waſhed *needle-tin* from *Polgooth*, and obtained nearly the ſame reſult.

3.) *Hundred* grains of *brown tin-ſtone* from *Schlackenwalde*, decompoſed in the ſame manner, by means of cauſtic alkaline lye and muriatic acid, yielded 75 grains of reguline tin; but its portion of iron amonnted to ½ grain.

LXII.

LXII.

CHEMICAL EXAMINATION

OF THE

NATIVE SULPHURET OF TIN[*].

(Tin-pyrites. Zinnkies.)

THE *Tin-pyrites*, or *ſulphuret of tin*, which at *Wheal Rock*, in the pariſh of St. *Agnes*, in *Cornwall*, at the depth of 20 fathoms under ground, forms a vein of 9 feet in thickneſs, is the firſt, and as yet the only inſtance of a natural tin-ore mineralized by ſulphur. *Bergmann*[†], it is true, mentions ſuch an ore as coming from Siberia; but it has never yet been found there; and what this celebrated chemiſt has conſidered as ſuch, and examined, was not a true foſſil, but a ſuppoſitious product of art[‡].

The colour of this tin-pyrites is grey, of various degradations from the light to the dark, and in the purer ſpecimens approaching to the ſilvery white. It is found in ſmall lumps, poſſeſſes a moderate metallic luſtre, and exhibits an uneven, ſmall-grained fracture. Its texture appears to be foliated, and its fragments are, for the moſt part, indeterminately angular.

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[*] *Beob. u. Entdeck. a. d. Naturkunde.* vol. I. pages 155 and 169.

[†] *Opuſc. Phys. et Chem.* vol. III. page 158.

[‡] *Crell's Chem. Annalen.* 1790. vol. I. page 53.

gular. It is alſo very brittle, and eaſily triturated*. Its ſpecific gravity, as I found, is 4,350.

According to the following analyſis, the conſtituent parts of this ore are *Tin*, *Copper*, *Iron*, and *Sulphur*. For this reaſon, the name of *Bell-metal ore* has been given it, not very improperly.

Tin pyrites contains, beſides the copper chemically mixed with it as one of its conſtituent parts, likewiſe copper-pyrites; which in part is coarſely, and in part finely diſſeminated in it. From this accidental ingredient, I previouſly freed, as much as poſſible, the tin-pyrites, or native ſulphuret of tin, ſubjected to the following examination.

A.

Half an ounce of tin-pyrites was heated to redneſs in a ſmall glaſs-retort. In the receiver a moiſture was found, making about two drops, impregnated with ſulphureous acid. The neck of the retort became thinly lined with a little grey and yellow ſublimate, of about ½ grain of weight; which, when placed on a glowing coal, firſt ſmelled and burned like ſulphur; but after this, a faint odour of arſenic was perceptible. The tin-pyrites had loſt three grains of weight.

B.

[illegible] tin-pyrites were roaſted in a calcining-[illegible] phoſphorous flame could be obſerved.

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* [illegible] external properties of tin-[illegible]

By

he ore was converted into a red calx or oxyd,
:wo drachms and 20 grains. It was then mingled
parts of calcined borax, half a part of white glaſs,
urth part of colophony. Being introduced in
nto an aſſay-crucible (*Tute*), lined with powdered
and covered with common ſalt, it was kept in a
ong fuſion for half an hour: by which treatment
a metallic button of a grey colour, 10 grains in
it very brittle; ſo much ſo, that by a gentle ſtroke
hammer it flew in pieces. The remainder of
ed metal lay diſperſed in ſmall grains among the
t ſcoriæ, mingled with the charcoal-duſt, that was
to line the veſſel.

C

drachms of finely triturated tin-pyrites were
th an aqua regia, compoſed of one ounce of mu-
½ ounce of nitric acid. Within 24 hours the
rt of the metallic portion was diſſolved in it, with-
tion of heat; while the ſulphur roſe up, and float-
ſurface of the menſtruum. After the mixture
igeſted upon it for ſome time in a low ſand-heat,
t with water, and filtered it. It left 43 grains of
the paper, ſtill, however, mixed with metallic par-
Vhen the ſulphur had been gently burnt off on
re ſtill remained 13 grains; of which eight were
y nitro-muriatic acid. The remaining part was
ed with a little wax; upon which the magnet at-
e grain of it.—What remained was part of the
atrix, and weighed three grains.

ſolution of the metallic portion (*a*) was com-
carbonat of pot-aſh; and the dirty-green preci-

pitate,

pitate, thus obtained, was re-diſſolved in muriatic acid, diluted with three parts of water. Into this fluid a cylinder of pure metallic tin, weighing 217 grains, was immerſed. The reſult was, that the portion of copper contained in the ſolution, depoſited itſelf on the cylinder of tin; at the ſame time that the fluid began to loſe its green colour, from the bottom upwards; until, after the complete precipitation of the copper in the reguline ſtate, it became quite colourleſs.

c) The copper thus obtained weighed 44 grains. By briſk digeſtion in nitric acid, it diſſolved, forming a blue tincture, and left one grain of tin behind, in the character of a white oxyd. Thus the portion of pure copper conſiſted of 43 grains.

d) The cylinder of tin, employed to precipitate the copper, now weighed 128 grains; ſo that 89 grains of it had entered into the muriatic ſolution. From this, by means of a cylinder of zinc, I re-produced the whole of its diſſolved tin, which was looſely depoſited on the zinc in a tender dendritical form. Upon being aſſured, that all the tin had been precipitated, I collected it carefully, lixiviated it cleanly, and ſuffered it to dry. It weighed 130 grains. I made it to melt into grains, having it previouſly mixed with tallow, and under a cover of charcoal duſt, in a ſmall crucible; which done, I ſeparated the powder of the coal by elutriation. Among the waſhed grains of tin, I obſerved ſome black particles of iron, which were attracted by the magnet, and weighed one grain. Deducting this, there remain 129 grains for the weight of the tin. By ſubtracting again from theſe laſt thoſe 89 grains, which proceeded from the cylinder of tin employed for the precipitation of the copper (*b*), there remained 40 grains for the portion of tin contained in the tin-pyrites examined. Hence, including that one grain of tin, which had been ſeparated from the ſolution of the copper (*c*), the portion of pure tin contained in this ore amounts to 41 grains.

The *educts*, or ſubſtances, extracted in this proceſs from tin pyrites, were conſequently :

Sulphur	30 grains.
Tin	41
Copper	43
Iron	2
Vein-ſtone, or *gangue*	3
	119

Which makes in an *hundred* parts :

Sulphur	25
Tin	34
Copper	36
Iron	2
	97

However, this proportion of the conſtituent parts is not always conſtant. The darker varieties of tin-pyrites, in particular, are conſiderably poorer in tin ; as, from one of them I ſcarcely obtained one half of the above quantity of reguline tin : but their proportion of iron increaſes.

D.

Although, in the courſe of theſe experiments, no trace of any ſilver, or lead, which had been ſuſpected to exiſt as an ingredient in this foſſil, had appeared ; yet, for the ſake of greater certainty, I inſtituted the following trial. The tin-pyrites, that had been ignited in the retort (A) was treated with nitric acid ; which attacked it, emitting copious red vapours. After ſufficient digeſtion, I diluted the mixture with water, and ſeparated the remaining ſulphur and oxyd of tin by means of the filter; combining, afterwards, the clear, blue ſolution, both with muriatic and ſulphuric acids. But, by its continuing clear and unchanged, it ſhewed that neither ſilver nor lead are preſent in this ore.

E.

The ready ſolubility of tin, contained in this ore, in the nitro-muriatic, as well as in the muriatic acid, which does not take place in tin-ſtones, and all other oxyds of tin fully ſaturated with oxygen, is a ſufficient proof that, in this ore, the tin held in ſolution by the ſulphur, in a manner, approaches the ſtate of native, or reguline tin. This is farther corroborated by the following experiment.

1. *a*) I expoſed *half an ounce* of tin-pyrites, mixed with the ſame quantity of corroſive ſublimate, to a ſand-heat, in a ſmall retort, connected with a receiver. At the very firſt moderate action of the fire, a heavy fluid paſſed over, attended with heavy white vapours; and, on the increaſe of heat, a grey-yellow ſublimate, for the moſt part cryſtallized in needles, ſettled on the neck of the retort; at the ſame time that on its upper convexity an impure black-grey cinnabar, or ſulphuret of mercury, depoſited.

b) The ſtrongly-fuming fluid in the receiver, which gave out thick white fumes, weighed one drachm, and perfectly reſembled common *fuming liquor of Libavius*, or ſublimed ſolution of muriat of tin. From this, by dilution with water, and ſaturation with pot-aſh, the oxyded tin was thrown down, as a white, very tumid precipitate, which, edulcorated and dried, weighed 30 grains.

c) The ſublimate, ſeparated from the neck of the retort, was pulverized, digeſted with water, and filtered. The reſidue which it left on the paper amounted to 203 grains, when deſiccated. Theſe were diſſolved in nitro-muriatic acid, with the exception of 15 grains of ſulphur; and the mercury fell down, in the reguline ſtate, from the ſolution, by putting copper into it. The aqueous ſolution of the ſublimate, obtained by the digeſtion, and precipitated by carbonat of pot-aſh, afforded 16 grains of oxyded tin; which were added to the preceding (*b*).

d) The oxyd of tin was then diſſolved in muriatic acid, and again precipitated, in the metallic ſtate, by a piece of zinc, plunged into the ſolution. This reguline tin, when collected, waſhed, and melted with tallow, weighed 20 grains. I flattened it by beating with the hammer; cut it into pieces; digeſted it with nitric acid; and dropped Pruſſian alkali into the fluid, filtered off from the oxyd of tin. The few brown flocculi precipitated by that alkali, proved that the muriated tin had carried along with it a ſlight portion of copper.

2.) By way of a comparative experiment, I repeated this proceſs with a ſpecies of pure *tin-ſtone*; but, in this caſe, not the leaſt trace appeared of any ſolution of the tin. The mercurial ſublimate volatilized in its uſual needled form, and the tin-ſtone remained in the retort unaltered.

LXIII.

CHEMICAL EXAMINATION OF THE *MOLYBDAT OF LEAD,* (*Yellow Lead-ore*), *From* BLEIBERG.

FIRST SECTION[*].

1.) THE *yellow lead-ore*, or *Molybdat of Lead*, from *Bleiberg*, near *Villach*, in *Carinthia*, conſtitutes, in the genus of lead, a particular, very diſtinguiſhed ſpecies of ore, occurring in many beautiful varieties. Its colour is waxy-yellow, of various ſhades; ſome inclining to the reddiſh, others to the whitiſh-grey. For the moſt part it is cryſtallized in tables, of from four to eight ſides, which ſometimes ſtand ſingly on their edges, or narrow ſides, and, at times, are cellularly concreted. Thoſe ſpecimens of it are rather ſcarce in which the cryſtals form a cube, or an octahedron, inſtead of a table.

The matrix, in which this ore is imbedded, is a compact lime-ſtone, of a yellow, whitiſh, or grey colour.

2.) Moſt mineralogiſts ſeem to have become acquainted with this lead-ore, only ſince the time that *Jacquin*[†] publiſhed his treatiſe on it; after whom *Wulfen*[‡] has contri-

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[*] *Beob. u. Entdeck. a. d. Naturkunde.* vol IV. 1792, page 95; and vol. V. 1794, page 105.

[†] *Miſcellanea Auſtriaca.* vol. II. Vienna, 1787.

[‡] *Xav. Wulfen. Abhandlung vom Kärnthner Bleiſpathe.* Wien, 1785.

buted

ed to the knowledge of this ore, by the elegant and ac-
ate deſcription which he has given of it. As to the con-
ent parts of the yellow lead-ore, the following experi-
ts will ſhew that the ſubſtance with which the lead is
bined in this mineral is not the oxyd of tungſten, as has
erroneouſly ſuppoſed, but the *oxyd of molybdena.*

.) The firſt point which I had in view, was to ſeparate
lead-ore carefully from the adhering extraneous parts.
ding that diluted nitric acid ſhewed in the cold no
on on this foſſil, I affuſed upon the quantity of it deſ-
d for this analyſis ſmall portions of this acid; pouring
f again as ſoon as the efferveſcence ceaſed. This pro-
I repeated, till, at laſt, no more efferveſcence enſued on
ng a freſh portion of the acid. Upon this the ore was
ed with water, and deſiccated. The nitric acid em-
ed for this purification contained the calcareous earth
eeding from the matrix, which outwardly adhered to
ore, and formed gypſum with ſulphuric acid, by means
hich I precipitated it. At the ſame time, a conſidera-
ortion of a fine, red iron-ochre was waſhed off by this
eſs, which diſſolved by digeſtion in muriatic acid, leav-
a ſlight reſidue, conſiſting of lead-ore and ſiliceous
.

) *Two drachms* of the above-mentioned cryſtals of lead-
thus purified, were mixed with an equal quantity of
onated pot-aſh, and expoſed to the fire in a ſmall cru-
. It entered into fuſion without efferveſcence. The
gerated maſs exhibited a faint reddiſh tinge, and was
red on its upper part with ſcales, reſembling litharge.
ing ſoftened this alkaline maſs with water, and filtered,
urated the colourleſs ſolution with nitric acid. By
the mixture was not rendered very turbid; but, on the
day, I found the bottom of the glaſs covered with

tals of ⅓ of an inch long, ſtanding upright; which I examined as follows:

a) Their figure conſiſts of ſmall, brilliant, accumulated rhomboidal tables.

b) On the tongue they manifeſt a weak metallic taſte.

c) Under the blow-pipe, upon charcoal, they fuſe very quickly and calmly into little globules, or drops, which are inſtantly imbibed by the ignited coal.

d) In the ſilver ſpoon they melt into grey ſpherules, which become ſhrivelled as they cool; and, during the current of air, urged through the blow-pipe, they depoſit a white ſubſtance, which covers the ſpoon.

e) When put upon a globule of alkaline phoſphat, fuſed on the charcoal, they are rapidly diſſolved, and tinge it either of a graſs, or olive-green, according to the quantity in which they are added.

f) They entirely diſſolve in water, by the aſſiſtance of heat.

g) Pruſſian alkali produces from this ſolution a copious, flocculent precipitate, of a *light-brown* colour.

h) If, into the aqueous ſolution (*f*) a little muriatic acid be dropped, and a ſmall piece of tin be put into it; or, if ſome of thoſe cryſtals are immerſed in a muriatic ſolution of tin; in both theſe caſes the fluid acquires a *deep-blue* colour.

In conſequence of theſe appearances, I think I do not err in conſidering theſe cryſtals as *molybdic acid*, neutralized

by

pot-aſh; becauſe, in a comparative experiment, the ſame relations were ſhewn by molybdic acid, that had been prepared from molybdena of *Altenberg*, by detonation with nitre, and ſubſequent precipitation, effected by nitric acid, from the filtered ſolution of the maſs produced by the detonation, and which acid likewiſe aſſumed a cryſtalline form in drying.

5) As it was obvious, from the ſtate of the calciform lead, which remained on the paper when I filtered the ſolution of the fuſed maſs (4), that the whole of the yellow lead-ore employed had not been decompoſed, I repeated the experiment, increaſing, however, the proportion of the alkali; ſo that, for two drachms of the ore, I took 10 drachms of carbonated pot-aſh. I alſo kept the maſs for a ſomewhat longer time in fuſion; after which it was poured out, levigated, ſoftened with water, and thrown upon the filter. This alkaline ſolution I ſaturated with muriatic acid, at firſt only incompletely; whereby, at a warm temperature, a white precipitate was produced, in the form of a cheeſy coagulum. This precipitate contained, indeed, molybdic oxyd, but mixed with a greater portion of oxyded lead; which laſt, upon ſolution in muriatic acid, ſeparated in needle-ſhaped cryſtals of muriat of lead.

When this precipitate had been ſeparated from the alkaline ſolution, which before was ſaturated with only half the quantity of muriatic acid required, I combined that fluid with an additional portion of the ſame acid to its complete ſaturation. It became again turbid, but only moderately ſo. Upon this, a white precipitate accumulated, like ſtarch, ſubſiding in cold water; which, carefully edulcorated and dried, was examined in the ſame manner as the cryſtalline precipitate mentioned before, (4). Its habitudes were perfectly the ſame; except that it would not diſſolve alone in water, but formed a clear ſolution, only when a few drops of muriatic acid had been added.

The fluid was now concentrated by evaporation; after which the oxyd of molybdena, ſtill contained in it, fell down as a fine, *heavy*, *yellow powder*; which, after proper lixiviation and drying, exhibited a beautiful, ſaturated lemon-colour.

6.) The white oxyd of lead, which remained upon the paper on filtering the ſoftened maſs, produced by the fuſion of the ore with pot-aſh (4), was found contaminated with a portion of ſiliceous earth. When treated upon charcoal, it did not entirely melt into a metallic button; but part of it was converted into a clear, bright, yellow globule of glaſs of lead (vitreous oxyd): for the admixed ſiliceous earth prevented the reduction of the whole portion of lead; in the ſame manner, as is the caſe when it is attempted to reduce upon charcoal a glaſs of lead, that has been made of three parts of oxyded lead and one of ſilex. For this reaſon, I diſſolved the above-mentioned oxyd of lead in dilute nitric acid, ſeparated the ſiliceous earth by filtration, and precipitated the metal from the ſolution, by means of ſulphuric acid, in the character of ſulphated lead.

7.) I likewiſe examined the actions of ſome of the acids upon this *Carinthian lead-ore*.—One drachm of it was digeſted with a copious quantity of nitric acid; which diſſolved the greateſt part, but not the whole of it. In the ſolution were obſerved white, looſe flocculi diſperſed, which dried upon the filtering paper in the form of a membrane, and became tarniſhed of a blue by expoſure to day-light. This ſubſtance had much reſemblance to the molybdic oxyd, obtained from molybdena in the humid way, by repeatedly diſtilling nitric acid from it. The filtered nitric ſolu-

tion contained, beſides the portion of lead, a conſidera-
quantity of molybdic oxyd. Sulphuric acid precipitated
lead from it; and Pruſſian alkali afterwards threw
n the molybdena in looſe, brown, red particles.

.) *One drachm* of this yellow-lead ore, previouſly puri-
, afforded a clear ſolution, by digeſtion with muriatic
. The ſolution went on gradually, and was nearly
plete and colourleſs; but it ſoon depoſited white cryſ-
of muriated lead. Only a ſlight portion of ſilex was
behind, which I ſeparated. While I was concentrating
fluid, the ſaline cruſt ſettling on the ſides of the evapo-
ng diſh became tarniſhed of a fine blue; which as often
ppeared as the cruſt was re-diſſolved in the fluid, on gen-
gitation. When the concentrated fluid had been de-
ed from the muriat of lead, which ſtill ſubſided, it af-
ed a beautiful deep-blue, but loſt that colour again by
tion with water. When afterwards ſaturated with pot-
it dropped a white oxyd of molybdena.

.) *Oxyd of lead*, and *oxyd of molybdena*, therefore, are the
tituent parts of the *yellow lead-ore* from *Bleiberg*, in
inthia. This combination is remarkable, as it is the
inſtance of the kind; ſince molybdena has not yet oc-
ed any where, except in its proper ore (*Waſſerbley*).
n the foregoing experiments there alſo reſult ſome other
rvations, by which the knowledge of the chemical pro-
ies of that metallic ſubſtance (*molybdena*) is greatly en-
ed. To theſe belongs its external form, as it occurs
y in the cryſtalline ſtate, partly as a white, and partly
lemon yellow oxyd. In the *firſt* ſtate, it is ſoluble in
le water, as well as in acids; in the *ſecond*, a
l addition of muriatic acid promotes its ſolution in wa-
but in the third, or that of a yellow oxyd, it refuſes
ſſolve both in water and in acids. The cauſe of this

difference conſiſts in this, that in the two firſt caſes it has been neutralized with the portion of alkali that remained combined with it; whereas, in the laſt caſe, that is, in the form of a yellow earth, it is more in the ſtate of a mere metallic oxyd.

10.) This appearance of the molybdic oxyd with a yellow colour, has probably been the reaſon for conſidering the ſubſtance, by which this yellow lead-ore is mineralized, as tungſtic acid.

However, the blow-pipe alone is ſufficient to diſtinguiſh theſe two metallic ſubſtances from each other; for, the yellow *molybdic oxyd* loſes its colour at the firſt contact with the point of the flame, and is rendered *olive-green*; it alſo immediately runs into a ſmall globule, or drop, which is very ſoon abſorbed by the charcoal; and, laſtly, when fuſed with a neutral phoſphat, it tinges the button which thence ariſes of a *green* colour.

The *yellow oxyd of tungſten*, on the contrary, exchanges, by ignition, its yellow colour for a *blue* or *black*, at the ſame time that it remains upon the charcoal as perfectly infuſible; and when fluxed with phoſphoric ſalt, it gives a *ſky-blue* colour to the ſaline globule.

SECOND SECTION.

Having thus obtained, by means of the experiments here explained, the knowledge of the *conſtituent* parts of the *yellow lead-ore* from *Carinthia*, I had yet to diſcover their *proportions* to each other. This I accompliſhed in the following way.

a) *A hundred* grains of the cryſtals above deſcribed were carefully freed, in the manner before mentioned, from the ering calcareous earth and ochre of iron, and then finely verized. They were then diſſolved in muriatic acid, ted by heat, alternately affuſing upon them the acid, a large quantity of water. In this inſtance a trace of eous earth, though ſcarcely diſcernible, appeared.

) The greateſt part of muriat of lead, generated in the eſs, was depoſited in fine needles, even before the ſolu- had completely grown cold. The ſuper-natant clear d was then poured off, reduced to a ſmaller volume by poration, and freed from the muriated lead, which ſtill rated. The muriated metal, collected with care, and kly deſiccated, weighed 74½ grains. By diſſolving it hot water, and ſteeping into the ſolution a poliſhed e of iron, the lead precipitated upon this laſt in fine ellæ, and in the metallic ſtate.

) But in order to find more accurately what proportion muriated lead might bear to pure oxyd of lead, I made following experiment.

wo hundred grains of lead, cut into ſhreds, were diſ- ed in 300 grains of nitric acid, diluted with 10 ounces water, and, with the aſſiſtance of digeſtion, in a boiling . The ſolution was then divided into two parts.

α) Into one half I dropped muriatic acid, as long as it produced any turbidneſs; evaporating afterwards the mixture to the moſt perfect dryneſs of the reſidue. The muriat of lead here produced weighed 133 grains.

β) From the ſecond half of the nitric ſolution I precipitated the oxyd of lead by diſſolved cauſtic potaſh. This oxyd, when edulcorated and briſkly dried till it began to turn yellowiſh, amounted to 115 grains.

A.

a) Upon *two hundred* grains of the ore, coarſely powdered, moderately ſtrong nitric acid was affuſed, which attacked and diſſolved them with frothing and extrication of red vapours. The ſolution was clear, and the ſulphur alone in the ore was left behind, floating in the fluid, in grey, looſe, flocculi, without any other reſidue; which indicated that no antimony was preſent. The ſulphur collected on the filter was heated in a ſmall crucible to inflammation, and it burned with its peculiar odour, without any trace of arſenic; yet leaving a ſlight portion of oxyded iron and ſiliceous earth.

b) The ſolution, which had a pure blue colour, was treated firſt with muriat, and then with ſulphat of ſoda. But none of theſe, nor any other ſalt, rendered it turbid, or produced any other alteration; by which it appears, that this ore contains neither *ſilver* nor *lead*.

B.

a) To determine, with proper accuracy, the proportion of the conſtituent parts, I repeated the examination in the following manner. *Two hundred* grains of the powdered ore were combined and heated with muriatic acid, to the degree of boiling. But as this acid alone manifeſted no action on it, I added nitric acid gradually, by drops; which exerted a ſtrong attack in each inſtance. When the ſolution of the ore had been accompliſhed, I ſeparated the fluid from the ſulphur floating on the ſurface; and digeſted this laſt once more with a freſh quantity of muriatic acid, dropping into it ſome nitric acid; after which I collected it upon the filter. This ſulphur, waſhed and deſiccated, weighed 38½ grains, out of which, after its combuſtion, 1½ grain *ous earth* remained; ſo that the true amount of 37 grains.

olution exhibited a glaſs-green colour. I di- two parts. Into one half poliſhed iron was pon which the *copper* precipitated of a dendriti- id pure metallic brilliance. It weighed 78½ n waſhed, and immediately deſiccated in a mo- rature.

r to aſcertain the proportion of iron contained I combined the other half of the ſolution with oniac added to exceſs of ſaturation. The pre- n remained behind, in the form of a ſubtle which, collected on the filter, deſiccated and ghed three grains. But as the iron is contained ure of the ore, not in this calciform ſtate, but ne, which laſt is to the firſt in the proportion eſe 3 grains of oxyded iron give 2¼ of *metallic* ded in the computation.

, *hundred* parts of the *Siberian vitreous copper-*:

r . . . . . B	*b*) . . .	78,50
. . . .	*c*)	2,25
bur	*a*) . . .	18,50
. . . . . .	*a*) . . .	0,75
		100

C.

es eminently belong to thoſe kinds, the com- iples of which are but imperfectly determined *in the dry way*. The reaſon of this is, partly, that the alkaline ſalts employed for the reduction, exert, during fuſion, as well as in the humid way, a very ſtrong ſolvent power on copper.

But although the reducing flux, compoſed of glaſs, borax, and charcoal-duſt, recommended by *Gellert*, *Tillet*, and others, inſtead of alkalis, is reckoned one of the beſt; yet I have always found the common *black-flux*, if employed in the following manner, the moſt effectual.

Two *docimaſtic centners* (each of 100 parts, conſidered for as many pounds), of the triturated ore were mixed with half a centner (or 50 parts), of charcoal-duſt, and properly roaſted until all the coal was conſumed *. I then blended it with ½ centner of colophony and 6 centners of the black flux, covering the maſs in the aſſay-crucible with common ſalt, and expoſing it to a forge heat. After the coals were completely red, the blowing of the bellows was kept up for 20 minutes. The fuſion being accompliſhed, I found, under a well-fluxed ſcoria, 138 parts of a fine *red*, or *refined copper*; which is 69 *per cent.*

However regularly this aſſay in the *dry way* was performed, yet it produced 9½ *per cent.* leſs than the true proportion of the copper in the ore amounts to. The *humid way*, therefore, is, in every reſpect, the moſt certain to diſcover the true quantity of copper in any ore.

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* The roaſted-ore weighed 210 pounds.

LXV.

CHEMICAL EXAMINATION

OF THE

VARIEGATED COPPER-ORE.

(Bunt-kupfererz. Purple Copper-Ore, by Kirwan.)

THE *variegated Copper-ore* is diſtinguiſhed in its external appearance from the *vitreous*, to which it is the neareſt a-kin, by its variegated colours, reſembling thoſe of tarniſhed ſteel; and, with regard to its conſtituent parts, it differs from it in containing leſs copper, but, on the contrary, more iron.

FIRST SECTION.

Variegated Copper-Ore from Hitterdahl.

THE variegated copper-ore occurring at *Hitterdahl*, in *Norway*, in lumpy maſſes, exhibits, on its recent fracture, a mixture of colours of light-blue, tin-white, and copper-red; which, however, by expoſure to air, gradually change into a more uniform ſteel-blue.

A.

One hundred grains of the pulverized ore were ſubjected to gentle digeſtion with nitric acid, whoſe action upon it was but moderate. From the reſidue, the ſulphur was driven out by combuſtion. This reſidue, when a ſecond time digeſted with nitric acid, diſſolved in it, leaving only a ſlight portion of a red oxyd of iron. On examining the

ſolution,

ſolution, firſt by common ſalt, and then by Glauber-ſalt, it continued limpid and unchanged.

B.

a) Upon *two hundred* grains of the powdered ore muriatic acid was affuſed, the mixture heated, and then combined in ſmall portions with nitric acid. The ſolution, which was thus performed, had a brown colour while concentrated; but as ſoon as it was diluted with water, it acquired a green. The remaining ſulphur was grey, tenacious, and ſpongy, and weighed 72 grains when dry. By ſlow combuſtion it left 35 grains, of which, after extraction by muriatic acid, five grains ſtill remained behind. Theſe loſt one grain more of ſulphur by burning, and the remaining four grains diſſolved entirely in muriatic acid. Whence the quantity of *ſulphur* amounted to 38 grains.

b) The muriatic ſolution was divided into *two* equal parts; and the *copper* was precipitated from one of them by means of iron. It amounted to 69½ grains.

c) The other half was ſuper-ſaturated with cauſtic ammoniac, and the oxyd of iron which fell down was collected. This, when moiſtened with linſeed-oil, and expoſed to a low red-heat, weighed 10 grains; which are equal to 7½ grains of *metallic*, or reguline *iron*.

Thus, in *one hundred* parts of this *variegated copper-ore* from *Norway* were found:

Copper	B. *b*)	69,50
Sulphur	*a*)	19
Iron	*c*)	7,50
Oxygen		4
		100

ſupplying the deficiency in the ſum of weights of the
er, iron, and ſulphur, from the hundred, by putting
n in the account, I mean to characterize this laſt as
nſtant conſtituent part of the variegated copper-ore,
ıcing in it thoſe variegated colours: in the ſame man-
as in ſteel, in copper-pyrites, and other metallic ſub-
es, the beginning of their oxydation is indicated by a
ar diverſity of colours.

the laſt mentioned ſubſtances, however, the change-
colours are only owing to external cauſes; for which
n, they preſent themſelves only on the ſurface, when
expoſed to air. On the contrary, the variegated cop-
re is penetrated throughout its whole maſs by the oxy-
g principle. This correſponds with the deficiency
eight to make up the ſum of the fixed conſtituent parts
e ore here analyſed; whereas no ſuch loſs is obſervable
e vitreous copper-ore, treated and decompoſed by the
method. It is on this account alſo, that the action of
itric acid is leſs ſtrong, and the diſengagement of ni-
gas is leſs copious, in the variegated than in the vitre-
opper-ore.

SECOND SECTION.

Variegated Copper-Ore from Rudelſtadt.

HE native place of this variety of variegated copper-ore
mine *Friederike Juliane*, at *Rudelſtadt*, in *Sileſia*, in
h a rich vein has lately been opened, of beautiful na-
ſilver, imbedded in ponderous ſpar, and accompanied by
nidal red ſilver-ore, along with cryſtallized white co-
re (*Glanzkobalt*), that has raiſed the ardent wiſhes of
roprietors for its continuance.

A.

Two hundred grains of the powdered ore, having been twice extracted by means of nitric acid, left behind their ſulphureous ingredient, together with a quantity of red oxyd of iron. The ſolution was filtered, and tried by proper reagents for ſilver, lead, zinc, arſenic, and the like, and it afforded no indication of theſe, but only of copper and iron.

B.

a) *Two hundred* grains of this ore, in pure pieces, freed from interſperſed quartz, were triturated, and treated with muriatic acid, to which a little nitric acid was afterwards added, and the extraction continued in a moderate warmth. The colour of the filtered ſolution was a celadon, or blueiſh green, with a ſhade of grey. The reſidue, porous like ſponge, weighed at firſt 88 grains; but only 56 grains, after its ſulphur had been gently burned off. Theſe, digeſted in a low heat with muriatic acid, ſoon diſſolved, forming a brown fluid, and left ſix grains more of ſulphur behind. Hence, the *ſulphur* contained in thoſe 200 grains amounted to 38 grains.

b) Theſe ſolutions were mixed together, and divided into *two equal parts*. From one half I precipitated the *copper* in due manner by means of a poliſhed piece of iron, and obtained 58 grains.

c) The other half was treated with cauſtic ammoniac, until the oxyd of copper, precipitated in the beginning, again diſſolved. The oxyd of iron, thus obtained, when collected on the filter, waſhed and deſiccated, was moiſtened with linſeed-oil, and ignited in a covered crucible. It weighed 24 grains. Hence, as, upon an average, four parts of oxyded iron, attractible by the magnet, are to be eſtimated as equal to three parts of reguline iron, I reckon 18 grains of *metallic iron*, inſtead of theſe 24 grains.

Since, for the ſame reaſon as in the foregoing analyſis, the loſs of weight in the ſum of the fixed conſtituent parts muſt be taken for the *oxygen* combined with the ore, and which eſcaped in the proceſs; the conſtituent parts of the *Sileſian variegated copper-ore*, and their proportions in the *hundred*, will be:

Copper	B. *b*)	58
Iron	*c*)	18
Sulphur	*a*)	19
Oxygen		5
		100

C.

With a view of making an *aſſay in the dry way*, I roaſted two docimaſtic centners with half a centner of powdered charcoal. The roaſted ore, now weighing 206 lb. was then mixed with half a centner of colophony, and ſix centners of black flux. In this ſtate it was put in a crucible, and covered with muriat of ſoda. When kept in fuſion during 20 minutes before the nozzle of the bellows, it yielded a fine button, weighing 96 lbs. of red, or refined copper; which is 48 *per cent.* and hence, 10 lbs. ſhort of what was obtained in the *humid way*, (B. *b*).

LXVI.

CHEMICAL EXAMINATION OF THE *SIBERIAN MALACHITES.*

a) ONE *thouſand* grains of compact, reniform *Malachites*, from the *Turjin* mines, on the *Ural*, were reduced to powder, and heated to complete redneſs in a ſmall glaſs retort, connected with the pneumatic apparatus. Much carbonic acid gas was diſengaged in this proceſs, to the amount of 252 cubic inches, without reckoning that part which was abſorbed by the water of the apparatus. This gas was entirely abſorbed by lime water, at the ſame time that a proportionate quantity of carbonated or crude calcareous earth was produced In the intermediate ſmall receiver a moiſture collected, weighing 78 grains, which, upon trial, proved to be pure water.

b) The pulverulent reſidue taken out of the retort appeared of a black colour, and weighed 716 grains. To ſerve for the following experiments, it was divided into four parts, at 179 grains each; and hence correſponding to 250 grains of the rough malachites.

1.) *One hundred and ſeventy-nine* grains of *ignited malachites*, combined with three times its quantity of black flux, were put into an aſſay-crucible, without lining it, and covered with *muriated ſoda*. In this ſituation it was committed to the fire of the blaſt-furnace, and when the coals had become red-hot without the action of the bellows, it was kept melting for

the ſpace of twenty minutes. After cooling, it was
ſerved that, in the broken retort, the whole mixture, un-
the covering of common ſalt, had run into an uniform,
npact, and opake maſs, of the bright red-colour of ordi-
ry ſealing-wax, and that no metallic button had been
rmed.

It follows from this, that there was not carbon enough
ſent to take up entirely the oxygen of the metallic oxyd.
erefore the copper has, by means of this ſmall remainder
oxygen ſtill united with it, been brought into the ſtate
red oxyd of copper; and, as ſuch, it has diffuſed itſelf
formly through the alkaline ſalt.

.) *Hundred* and *ſeventy-nine grains* of *ignited malachites*
re mingled with three times their quantity of *black-*
, and 1-10th of *powdered charcoal.* When fuſed in this
e, during 20 minutes, under a ſtratum of *common ſalt*, in
ſſay-crucible not lined in the inſide, they afforded a but-
of reguline copper, which had run well together, and
ghed 136½ grains.

) Another 179 grains of *ignited malachites*, mixed with
e as many grains of *black-flux*, and one fifth part of their
ht of *colophony*, and likewiſed fuſed for 20 minutes, under
ver of muriat of ſoda, in a crucible not ſecured by
g, yielded a well-melted button of reguline copper,
hing 138 grains.

) The remaining 179 grains of *ignited malachites* were,
the preceding, melted during the time of 20 minutes,
r a cover of *common ſalt*. But the aſſay-crucible had
iouſly been lined with powdered charcoal, and the
chites mingled with an equal weight of *calcined borax*,
half its quantity of *white glaſs*, and 1-4th part of *colo-*

phony, or boiled turpentine. By this proceſs I obtained, indeed, a well-fuſed button of reguline copper; but with a conſiderable loſs, as it weighed only 105¼ grains.

B.

In order to diſcover more accurately the conſtituent parts of malachites, I performed the following experiments.

a) 100 grains of malachites, reduced to powder by trituration, were diſſolved in nitric acid; which was effected without leaving any reſidue. The ſolution had a bright-blue-colour, and was ſaturated to exceſs with cauſtic ammoniac: but the precipitate produced was entirely, and without turbidneſs, re-diſſolved by the exceſs of the alkali. This ſhewed that the malachites here examined was perfectly free from iron, and ſimilar admixtures.

b) I combined *hundred* grains of triturated malachites with a ſufficient quantity of ſulphuric acid, previouſly diluted with five parts of water, and accurately weighed together with the veſſel. After the malachites had been wholly diſſolved, which was effected gradually, and with a moderately ſtrong effervеſcence, the loſs of weight, occaſioned by the *carbonic acid gas* that was extricated, was found to conſiſt of 18 grains.

c) *One hundred* grains of the ſame powdered malachites were ignited, at a moderate heat, in a covered crucible. The black reſidue had loſt 29½ grains in weight. If from theſe be ſubtracted 18 grains for the carbonic acid, the remaining 11½ grains of loſs will conſiſt of *water*.

Another

d) And laſtly, 100 grains, which had been diſſolved in dilute ſulphuric acid, and precipitated by zinc, yielded 58 grains of pure *copper*.

In conſequence of theſe experiments, the *Siberian malachites* conſiſts, in the *hundred*, of:

Copper	58
Carbonic acid	18
Oxygen	12,50
Water	11,50
	100

LXVII.

CHEMICAL EXAMINATION

OF THE

BISMUTHIC SILVER-ORE,

From *Schapbach*, in the *Black-foreſt*,

In Suabia.

THE *Biſmuthic Silver-ore*, which occurs in the mine *Friederich-Chriſtians*, in the valley *Schapbach*, in the *Black-foreſt*, *(Schwarzwald)*, and for the firſt acquaintance with which we are indebted to Mr. *Selb**, Maſter of the mines at *Welfach*, has been deſcribed, as to its external characters, by *Widenmann*† and *Emmerling*‡. This mineral deſerved a complete chemical inquiry ſo much the more, as even now ſeveral *Mineralogiſts* ſtill ſeem to doubt of the exiſtence of this peculiar ſpecies of ores.—For this reaſon, I publiſh here its analyſis, which to perform I was enabled by Mr. *Selb*, ſending me of this mineral the quantity neceſſary for the purpoſe.

Since this ore is very much concreted with the *grey quarz*, ſerving to it as a matrix; and ſince in moſt ſpecimens it can be conſidered as only diſſeminated in the quarz, I have employed for its analyſis merely ſuch pieces as are the leaſt mixed with quarz, and, at the ſame time, the moſt free from copper-pyrites and galena, which accompany this ore.

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* Crell. Annalen, [illegible] I. Band, Seite [illegible].

† Handbuch der Mineralogie, [illegible] 1794. page 716.

‡ Lehrbuch der Mineralogie, II. Theil. Gieſſen, 1796. Seite 25[illegible].

A.

A.

Examination in the dry way.

iſmuthic ſilver-ore, in ſmall fragments, be ignited
rcoal before the blow-pipe, there ſoon tranſude
lrops of eaſy fuſion; which *eliquate** more perfectly
ldition of borax. The glaſs of borax acquires by
ellow colour, reſembling that of amber (*Succinum*),
l with white, and in ſome places alſo with a cop-
The metallic button exhibits variegated colours,
nues long in fuſion. It is brittle, and appears of a
in the fracture.

ien *three hundred grains* of this ore, previouſly tri-
had been expoſed to a red-heat, in a ſmall retort,
ſand, they afforded,—beſides a ſlight quantity of
moiſture, no more than 2½ grains of ſulphur; the
ow colour of which proved the total abſence of
On the powder of the ore, which coaleſced but
ly, ſome metallic drops were found incumbent.
ien roaſted in an open teſt, until no trace of ſul-
ſmell could be obſerved. After this proceſs, it
ſh-grey colour, appeared of a very looſe texture,
hed 313 grains.

ng combined with 1½ ounce of black flux, and re-
in aſſaying-crucible, under a layer of culinary ſalt,
o a tin white metallic button, which weighed 174
ould admit of being cut with a knife, and, though
ome malleable, yet was brittle, and fell aſunder
e blows of the hammer.

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ie proceſs of *eliquation*, in general, ſee *Gren's Principles*
ry, Lond. 1800, vol. II. page 301.—Tranſl.

This metallic bead, when refined by cupellation, under the muffle, afforded a button of *pure reguline ſilver*, weighing 33½ grains.

B.

Examination in the humid way.

a) Upon *three hundred* grains of this ore I poured three ounces of nitric acid, diluted with one ounce of water. A great part of it diſſolved in this menſtruum, even in the cold. The reſidue was afreſh combined with one ounce of the ſame acid, weakened with half an ounce of water, and digeſted in a gentle heat. Both ſolutions, thus obtained, were filtered, mixed, and together evaporated to a ſmaller volume; during which proceſs there ſeparated from the fluid ſome cryſtalline grains, conſiſting of nitrat of lead.

b) The concentrated ſolution had a greeniſh colour.—When afterwards diluted with juſt as much of water as was requiſite to re-diſſolve that cryſtalline ſediment, it was poured into a large quantity of water. This laſt immediately acquired a milky appearance, in a high degree, and depoſited a white precipitate, which weighed 44½ grains, when collected, lixiviated, and dried in the air, and proved, on further examination, to be *oxyd of biſmuth.*

c) Into the liquor, that had been freed from this oxyd, and was entirely clear and colourleſs, I then dropped muriatic acid, as long as it was rendered turbid by it. The precipitate which then enſued, did not appear to be mere muriat of ſilver; for this reaſon, I digeſted it for ſome time with a moderately ſtrong nitric acid. A conſiderable portion of it was thus re-diſſolved, and left pure horn-ſilver behind; which, upon careful collection, and deſiccation in a briſk heat, weighed 45 grains. Thus, the portion of pure ſilver is determined at 34¼ grains.

d) The nitric acid, that had been affuſed upon the pre-itate obtained by the muriatic (*c*), yielded, by dilution ith much water, 32 grains more of oxyded biſmuth; which, ith the preceding 44½ (*b*), gave together 76½ grains.

In order to aſcertain the proportion of reguline biſmuth this ore, I diſſolved 100 grains of biſmuth in nitric acid; d after having concentrated the ſolution by evaporation, poured it into a large quantity of water. When of the ecipitate, thus produced, nothing more would fall down, adding more water, I collected it on the filter, waſhed , and ſuffered it to dry perfectly in the air. It then weigh-l 88 grains. To the water, which had been ſeparated om it, muriatic acid was added by drops; whereby a new ecipitate enſued, weighing 35 grains, after edulcoration d drying.

As, by the reſult of this comparative experiment, *one undred* grains of *reguline* biſmuth have, upon the whole, iven 123 grains of *oxyded* biſmuth; it follows, that the 6½ grains of biſmuthic oxyd, mentioned at (*d*), and obtain-l from 300 grains of the biſmuthic ſilver ore, contain 62⅕ rains of *metallic*, or *reguline biſmuth*.

e) The remainder of the fluid was farther reduced by vaporation; and, in this proceſs, muriat of lead ſeparated rom it in delicate, broad-ſtriated cryſtals. This liquor vas then combined with ſuch a quantity of ſulphuric acid, s was requiſite to re-diſſolve thoſe cryſtals, and a ſecond ime evaporated to a conſiſtence of pap. The precipitate, vhich thence enſued, was ſulphat of lead, weighing 19 rains, when duly collected, waſhed, and dried.

f) What ſtill remained of the ſolution, after its having een freed from the lead before contained in it, was ſaturated with cauſtic ammoniac added in exceſs. In this way a brown ferruginous precipitate was produced; which was rapidly attracted by the magnet, and weighed 14 grains, when, after previous deſiccation, it had been moiſtened with linſeed-oil, and well ignited.—For theſe we muſt reckon 10 grains of metallic iron.

g) The liquor, which had been ſuper-ſaturated with ammoniac, and which, by its blue colour, ſhewed that it held copper in ſolution, was next ſaturated to exceſs with ſulphuric acid. On immerſing then a piece of poliſhed iron into it, two grains of *copper* were depoſited.

h) The grey reſidue of the ore, that was left behind by the nitric acid (*a*), weighed 178 grains. But when its ſulphureous part had been deflagrated, in a crucible gently heated, it weighed only 140½ grains. This determines the portion of *ſulphur* at 37½ grains.

i) Theſe 140½ grains were digeſted with *three ounces* of muriatic acid, in a heat of ebullition; and this proceſs was repeated once more with 1½ ounce of the ſame acid. Theſe ſolutions, by means of evaporation, yielded till the end muriat of lead in tender ſpicular, and likewiſe in broad-ſtriated cryſtals; which, when again diſſolved in the requiſite quantity of boiling water, then combined with ſulphuric acid, and evaporated, yielded 89 grains of ſulphated lead. Thus the whole quantity of this ſulphat, including the 19 grains mentioned at (*e*), amounted to 108 grains; for which, according to comparative experiments, 76 grains of *reguline lead* muſt be put in the computation.

k) That portion of the ore examined, which ſtill remained after all the conſtituent parts before mentioned have en diſcovered, conſiſted merely of the *grey quarzoſe matrix*; weight of which, in the ignited ſtate, amounted to 70 ains.

Therefore, thoſe *three hundred* grains of *biſmuthic ſilver-*, mentioned above, were decompoſed into:

Lead	*i*)	76
Biſmuth	*d*)	62,20
Silver	*c*)	34,50
Iron	*f*)	10
Copper	*g*)	2
Sulphur	*h*)	37,50
Quarzoſe matrix	*k*)	70
		292,20 grains

It follows from this ſtatement, that, excluſively of the *rzoſe gangue*, the conſtituent parts of the *biſmuthic ſilver-* *alone* conſiſt, in the *hundred*, of:

Lead	33
Biſmuth	27
Silver	15
Iron	4,30
Copper	0,90
Sulphur	16,30
	96,50

[illegible] NIATED SILV

[illegible] Wolfach, in Suabia.

[illegible] foſſil, which is found onl[illegible] [illegible] principality of *Fürſtenberg*, i[illegible] [illegible] occurs there in the pit, called [illegible]; and its external characters [illegible] *[illegible]nmann** and *Emmerling*†, i[illegible] [illegible]ributions to Mineralogy.

[illegible] been proved by *Bergmann*‡, [illegible] by *Selb*§, that this mineral is [illegible] and *reguline antimony.*

[illegible] in his experiments that var[illegible] [illegible], which, in former times, has [illegible] [illegible] coarſe-granular detached pieces [illegible] ſilver to amount from 70 to [illegible] fine-granular variety, which [illegible] rich in ſilver.

FIRST SECTION.

Antimoniated Silver in fine Grains.

A.

Examination in the dry Way.

) A SMALL piece of antimoniated ſilver, when tried
n charcoal, with the aſſiſtance of the blow-pipe, ſoon
red into fuſion. The antimonial part volatilized
s uſual vaporous ſtate, and left the button of ſilver en-
ly pure behind. Neither of ſulphur nor of arſenic
trace appeared.

) Twenty-five grains, mixed with four times their
ght of lead, and ſubjected to cupellation, yielded a but-
of pure ſilver, weighing 21 grains.

B.

Examination in the humid way.

) Nitric acid was poured upon *hundred* grains of an-
oniated ſilver, freed from calcareous ſpar adhering to
nd pulverized as much as its toughneſs would admit.
acid ſhewed no conſiderable action in the cold.
erefore I ſubjected the whole to a digeſting heat, in
ch I kept it, until nitric acid, added afreſh, would not
her attack this powder. Upon this I diluted the
ture with water, ſeparated the reſidue, and precipi-
d the ſilver from the colourleſs ſolution, by means
opper. The *ſilver*, thus obtained, amounted to
grains, when lixiviated and dried in a warm tem-
ture.

LXVIII

CHEMICAL EX

OF

ANTIMONIA

from Wolfa

ANOTHER foſſil,

worked in the principal

ated Silver. It occurs

near *Alt-Wolfach*; and

deſcribed by *Widenm*

tary Introductions to

It has already be

cumſtantially by *S*

native ſilver and

Selb employ

niated ſilver,

frequently in

its proportion

dred. But

conſiderably

---

* *Hand*

† *Lehrb*

‡ Opuſ

§ *Mag*

---

amination of the

the water with which

arſenical oxyd in water

which are exhibited

arſenic. By combination

arſeniat of lime; with ſul-

yellow ſulphuret of ar-

pigment of *Scheele* with

of cobalt would no longer

with water, and precipitated,

oxyded cobalt; which,

and, towards the end, that

precipitated in muriatic

with water, the liquor ac-

afforded the well-known ſym-

alt.

parts of the *cryſtallized, white*

this analyſis, conſiſt, in the

cobalt itſelf, of 45 grains of

ſulphur: but of any portion

ſuppoſe that the ingredient

might, perhaps, not be the

aſcertain it more accurately in

the dry Way.

A.

white cobalt-ore, coarſely pow-

in a ſmall glaſs retort, con-

nected

and kept in the ſtate of ignition for ling there appeared in the neck of *one* grain of ſublimed arſenic, to- trace of ſulphur.

of the retort were then introduced into ds, and once more ſtrongly ignited; but enſued.

this, I mixed the cobalt with 1-4th part of its powdered charcoal, and calcined it in a ſhallow At this inſtant the arſenic eſcaped in vapours; y, and it coated metallic ſubſtances, that were held pot, with a thick white cruſt. The ſmell of this reſembled that of garlic, only in very moderate de- and it ceaſed to be emitted after the roaſting had been tinued for two hours.

But, by this calcination, the cobalt was not yet entirely deprived of all portion of arſenic; for, when it had been diſſolved in nitric acid, and the ſolution concentrated by evaporation, there was ſtill ſome arſenic depoſited.

B.

a) For this reaſon, another *two hundred* grains of rough, white, cobalt-ore, previouſly triturated, were, in the firſt inſtance, mixed with 100 grains of charcoal-duſt, and calcined. This roaſting was twice repeated, mixing the ore each time with 50 grains of powdered charcoal; after which it no longer emitted any trace of exhaling arſenic. The cobaltic oxyd, which now, to appearance, had been entirely freed from arſenic, weighed 104 grains, and exhibited a black colour.

tion. It again entirely diſſolved in the water with which it was boiled.

c) Both the ſolutions of the arſenical oxyd in water ſhewed exactly the ſame appearances which are exhibited by any other aqueous ſolution of arſenic. By combination with lime-water, they yielded *arſeniat of lime*; with ſulphuret of ammoniac they produced *yellow ſulphuret of arſenic* (orpiment), and the *green pigment* of *Scheele* with ammoniacal oxyd of copper.

d) When the nitric ſolution of cobalt would no longer depoſite any arſenic, I diluted it with water, and precipitated, by means of vegetable alkali, the oxyded cobalt; which, at firſt, had a peach-flower colour, and, towards the end, that of lilac. On diſſolving this laſt, precipitated in muriatic acid, and diluting the ſolution with water, the liquor acquired a roſe-red colour, and afforded the well-known ſympathetic ink prepared from cobalt.

Therefore, the conſtituent parts of the *cryſtallized, white cobalt-ore*, ſeparately produced in this analyſis, conſiſt, in the *hundred*, beſides the portion of cobalt itſelf, of 45 grains of arſenical oxyd, and ½ grain of ſulphur: but of any portion of iron no trace appeared.

However, as I had reaſon to ſuppoſe that the ingredient proportion of arſenic here ſtated might, perhaps, not be the true one, I endeavoured to aſcertain it more accurately in the dry way.

II. *Experiments in the dry Way.*

A.

a) Five hundred grains of white cobalt-ore, coarſely powdered, were heated to redneſs in a ſmall glaſs retort, connected with a receiver, and kept in the ſtate of ignition for ſome time. After cooling there appeared in the neck of the retort no more than *one* grain of ſublimed arſenic, together with a ſlight trace of ſulphur.

b) The contents of the retort were then introduced into a ſmall open matraſs, and once more ſtrongly ignited; but no ſublimation enſued.

c) Upon this, I mixed the cobalt with 1-4th part of its weight of powdered charcoal, and calcined it in a ſhallow open pot. At this inſtant the arſenic eſcaped in vapours; but ſlowly, and it coated metallic ſubſtances, that were held over the pot, with a thick white cruſt. The ſmell of this vapour reſembled that of garlic, only in very moderate degree; and it ceaſed to be emitted after the roaſting had been continued for two hours.

But, by this calcination, the cobalt was not yet entirely deprived of all portion of arſenic; for, when it had been diſſolved in nitric acid, and the ſolution concentrated by evaporation, there was ſtill ſome arſenic depoſited.

B.

a) For this reaſon, another *two hundred* grains of rough, white, cobalt-ore, previouſly triturated, were, in the firſt inſtance, mixed with 100 grains of charcoal-duſt, and calcined. This roaſting was twice repeated, mixing the ore each time with 50 grains of powdered charcoal; after which it no longer emitted any trace of exhaling arſenic. The cobaltic oxyd, which now, to appearance, had been entirely freed from arſenic, weighed 104 grains, and exhibited a black colour.

b) Theſe 104 grains were mingled with carbonat of potaſh and crude tartar, of each three drachms. The mixture, when introduced into a ſmall crucible, and covered with muriat of ſoda, was kept in the fire, before the nozzle of the bellows, during 20 minutes. The cobalt, thus reduced to the reguline ſtate, was found to weigh 75 grains. Its external ſurface had a finely knit, or interwoven appearance. But when I endeavoured to break it by the hammer, it proved to be hard, and ſomewhat tenacious. Its internal ſurface was partly porous; partly it exhibited a rough fracture, paſſing into the *hackly*, that is, preſenting ſharp points to the feel.

c) After theſe 75 grains of metallic cobalt had been pounded, they were roaſted, in a briſk fire, for two hours; upon which the calcined cobalt appeared again in the character of a black oxyd, with an increaſe of weight of 18 *per cent.*

Since it may be preſumed, with probability, that this cobaltic oxyd, which has been re-produced from the reguline cobalt revived at (*b*), contains oxygen in the ſame proportion with the oxyd prepared by roaſting the rough cobalt ore; and, as conſequently, thoſe 104 grains (*a*) of oxyded cobalt have contained 88 grains of pure reguline cobalt; it follows, that the conſtituent parts of this *white cobalt-ore*, from *Tunaberg*, are, in the *hundred:*

Reguline *cobalt* . . .	44
Sulphur	0,50
Reguline *arſenic* . . .	55,50
	100

LXX.

LXX.

CHEMICAL EXAMINATION OF THE *COBALTIC ORE OF MANGANESE,*

From RENGERSDORF, in *Luſatia.*

THE foſſil that was the object of the preſent enquiry occurs near *Rengersdorf*, in *Upper-Lusatia*, in a ſtratum of quarz, which, on the *Heideberg*, comes up to the day. It has, till now, been conſidered as a *black hæmatitic iron-ſtone*[*], until the late Profeſſor *Leske* has introduced it as a *black cobalt-ore*[†]. However, as he declared to entertain a wiſh that this claſſification, which he founded partly on the external characters of this foſſil, partly on ſome previous experiments made with it[‡], might be farther examined by a chemical analyſis, it was by this declaration that M. *Westrumb* was induced to undertake this taſk.

From the appearances which this celebrated chemiſt obſerved on experimenting with this foſſil, it reſulted, that it contained *mangane\ſe:* but, on the other hand, he denied it to contain a portion of *cobalt*[§], which, however, *Leske* had ſuſpected in it.

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[*] Schwarzer, Glasköpfiger Eisenstein.

[†] Schwarzer Erdkobalt.

[‡] *Reiſe durch Saxen* von N. G. *Leſke.* Leipzig, 1785. Page 230—230.

[§] *Kleine Phys. Chem. Abhandlungen,* von *Westrumb, 2ter* Band, 2 Heft, 1788, page 183.

My

grains, and was *oxyd of mangaueſe*. In order to try it for iron, I again digeſted it with nitric acid; in which, on the addition of a little ſugar, it immediately diſſolved, without leaving iron, or any other reſidue. When again precipitated by means of carbonated pot-aſh, it fell down as a carbonated oxyd of manganeſe, of a white colour, verging into the iſabella yellow.

f) Hence the nitric ſolution ſtill contained 98 grains of the mentioned 178; but from the firſt there muſt be ſubtracted *one* grain for copper, diſcovered in the ſequel. By mild vegetable alkali, this re-diſſolved portion was again precipitated, of a pale colour of peach-flower; and this precipitate, as the following examinations of it have ſhewn, conſiſted of an accurate mixture of *oxyds of cobalt* and *manganeſe*.

g) The 206 grains, which remained on diſſolving the crude foſſil (*a*), were mixed with twice their weight of carbonated pot-aſh, and moderately ignited during two hours; after which they were covered with water, ſuper-ſaturated with muriatic acid, and evaporated to a gelatinous conſiſtence: and when the *ſiliceous earth* had been ſeparated, waſhed, and ignited, it was found to weigh 114 grains.

h) I then neutralized the remaining muriatic liquor with carbonat of pot-aſh, and combined it afterwards with oxalat of pot-aſh: but by this neither any precipitation nor turbidneſs has been effected. It was then combined with cauſtic ammoniac, which threw down *aluminous earth*, the quantity of which, after ignition, conſiſted of 90 grains. The ſtill remaining portion of the fluid continued clear on the addition of carbonated ſoda.

i) With a deſign to aſcertain the proportion of copper which enters into this foſſil, and the preſence of which has already been obſerved in the previous experiments, I affuſed ſulphuric acid upon 500 grains of the rough foſſil, evaporated the fluid on a ſand-bath, ſoftened the inſpiſſated maſs with water, and immerſed, after filtration, a poliſhed plate of iron into the clear ſolution, which had acquired a pale roſe colour. The plate of iron became gradually incruſtated with a cupreous pellicle; which, when carefully collected, weighed no more than ½ grain; and thus one grain of *oxyd of copper* muſt be put in the computation.

Therefore, the *five hundred* grains of the foſſil here examined have been decompoſed into:

Oxyd of cobalt, mixed with *oxyd of magneſia*	B. *f*)		97
Mere *oxyd of manganeſe*	*e*)		80
Oxyd of copper	*i*)		1
Silex	*b*)	10	124
——	*g*)	114	
Alumine	*c*)	12	102
——	*h*)	90	
Water	A. *d*)		85
			489

C.

But, that the 97 grains mentioned at (B. *f*), and which were obtained in the carbonated ſtate, have really conſiſted of a mixture of oxyded cobalt and manganeſe, has been proved by the following experiments; the phenomena of which, at the ſame time, were compared with thoſe that are exhibited by the pure carbonated oxyd of manganeſe.

1. *a*) The colour of the above precipitate, in the carbonated ſtate, is the pale peach-flower red, and changes, on ignition, into the light-brown.

b) The

) The colour of the carbonated manganeſian oxyd is
te, inclining to the iſabella-yellow; and that of ignited
l of manganeſe is black-brown.

a) If the ignited cobalto-manganeſian precipitate be
ſted with nitric acid, in a boiling heat, it leaves behind
reſidue in the form of a ſubtle, black powder. If then
onated pot-aſh be added to the filtered ſolution, which
a very pure, but dilute roſe-red colour, the diſſolved
ter is thrown down by the alkali, of its former peach-
er red. The black reſidue, left unattacked by the
c acid, when heated to redneſs, and digeſted in a heat
bullition with a freſh portion of nitric acid, is re-
lved for the greateſt part; and its diſſolved portion is
n precipitated, of a pale red colour, by mild pot-aſh.

) The ignited black-brown oxyd of manganeſe, by it-
alone, is inſoluble in nitric acid; the acid that is boiled
h it continues colourleſs, and lets nothing fall down on
g ſaturated with an alkali.

ich continues unchanged by the outer, as well as by the er flame of a candle, directed on it by the blow-pipe.

) Oxyd of manganeſe, alone, produces with the phoſ- ric ſalt a globule, which is devoid of all colour when ed by the interior flame, but acquires an amethyſtine by the heat of the exterior.

5. *a.*) The combination of borax with the cobalto-manga- ſian precipitate, upon the charcoal, before the blow- e, produces a glaſs globule of a dirty blueiſh colour, in- ning to the blackiſh-grey. But as ſoon as a ſmall quan- y of arſeniated ſoda is added, a pure ſapphire-blue colour pears.

b) Oxyd of manganeſe imparts to borax, when vitrifying on the coal, a dark amethyſtine, and ſometimes a hyacin- ine red colour. But the glaſs globule is immediately ndered colourleſs by the addition of arſeniat of ſoda.

6. *a*) When the precipitate compounded of cobalt and anganeſe is diſſolved in concentrated muriatic acid, the lution acquires a pale roſe colour, and it becomes graſs- een by heating. As the ſolution cools, its green colour ſappears, and the pale-red returns. If this ſolution be luted with water, and employed inſtead of ink, the cha- cters written with it become viſible, of a green colour, warming the paper gently; but, upon cooling, that co- ur diſappears, and returns again when warmed; and ſo on, ternately. However, if the paper be heated too ſtrongly, e traces made on it acquire a brown and permanent lour.

b) The ſolution of oxyd of manganeſe alone, in concen- ated muriatic acid, is, for the moſt part, entirely colourleſs: neither does it acquire any tinge by warming it. The traces written on paper with this ſolution, previouſly diluted with water, continue inviſible if the paper be expoſed to a gentle heat only: but by a ſtronger heat they turn brown, and loſe no more that colour, even after cooling.

D.

All theſe phenomena ſufficiently evince the preſence of cobalt in the above compound reddiſh precipitate. However, ſince the colours exhibited by this precipitate are, in all their changes, paler than thoſe which are produced by the oxyd of cobalt prepared from genuine cobalt-ores, it appears that the cobaltic is its ſmaller part. The mangancſe, on the contrary, conſtitutes the greater portion: and it ſeems that in this precipitate there obtains an intimate union between theſe two metals: for, although a great part of the manganeſe may be made ſeparable by ſtrong ignition, by which it is rendered inſoluble in nitric acid; yet I could not ſucceed in ſeparating entirely the remaining part of manganeſe from the ingredient cobalt, by repeated ignition and boiling in nitric acid.

It is on account of the manganeſe, ſo intimately combined with the cobalt, that neither the crude foſſil, nor the reddiſh precipitate ſeparated from it, imparts a true blue colour to vitrifying ſubſtances.

Yet, notwithſtanding this, the mentioned arſenical addition (5. *b*) affords a practicable means of rendering the ingredient portion of mangancſe ineffectual in tinging glaſſes. The reaſon of this is, that the manganeſe combines, and enters into a ſtate of complete ſaturation with the oxygen, which it ſeizes from the admixed arſeniat of ſoda. And as, in this ſituation, it does not, of its own accord, tinge vitrifying ſubſtances, it likewiſe no longer prevents the cobalt from imparting a pure ſapphire-blue colour; as is confirmed by the following experiments.

1. To *five* parts of that peach-flower coloured precipitate, previouſly diſſolved in muriatic acid, I added a ſolution of *two* parts of arſeniated ſoda, and effected a precipitation by means of carbonated ſoda. The precipitate, in this inſtance, acquired a lavender-blue, inſtead of a reddiſh colour; and, when added to a globule of borax, melted upon charcoal, it immediately coloured it of a pure ſapphire-blue.

2. *a*) *Silex*	½ ounce of each.
Calcined borax	
Reddiſh cobalto-manganeſian precipitate	10 grains,

mixed and vitrified in a porcelain-pot, afforded a glaſs of a weak and cloudy amethyſt-colour.

b) *Silex*	½ ounce of each,
Calcined *borax*	
Of the above *lavender-blue arſenical precipitate* . . .	10 grains,

yielded a glaſs of a very pure ſapphire-blue colour, though not of that intenſity which an equal quantity of oxyded cobalt, prepared from the common good cobalt-ores, imparts to ſimilar glaſs-frits.

3. *a*) *Silex*	½ ounce of each,
Carbonated *pot-aſh* . . .	
Rough foſſil	2 drachms.

produced a ſmalt-blue glaſs, the violet colour of which too much inclined to a dirty brown-red.

b) *Silex* . . . . } ½ ounce of each,
Carbonated *pot-aſh* . . . . }
Rough foſſil . . . . 2 } drachms,
Arſeniat of ſoda . . . . . . 1 }

ve a ſmalt-blue glaſs, of a pure violet colour.

4. It yet remained to examine what colour would be
oduced by the cobaltic portion of this compound metallic
yd, in the encauſtic painting on porcelain. For this pur-
ſe, a part of the *lavender-blue arſenical precipitate*, pre-
red as before (No. 1.) was conveyed upon porcelain-
ſels, previouſly ignited, and then fuſed upon them. The
nting returned from the furnace in every reſpect of a pure
balt-colour, though rather weak.

Beſides theſe experiments, I performed a number of
hers with ſeveral variations, with a deſign of aſcertaining
e proportion of cobalt in the ore here examined, as well as
ſeparating its oxyd of cobalt in a ſtate entirely free from
admixture of manganeſe. But, ſince the reſult would

LXXI.

CHEMICAL EXAMINATION
OF THE
NATIVE SULPHAT OF COBALT.

(Kobaltvitriol)

From HERRENGRUND, *in Hungary.*

AT *Herrengrund*, near *Neuſohl* in *Hungary*, a vitrolic ſalt occurs, in pale roſe-red, tranſparent cryſtals, of a *ſtalactitical* form; which is conſidered by ſome as a *ſulphat of mangancſe*, but by others as a *ſulphat of cobalt.*

To remove this doubt, I undertook the following examination of this foſſil; and the reſult decided for the *latter* opinion.

Hundred grains of this metallic ſalt, when diſſolved in water, and precipitated by carbonat of pot-aſh, afforded ſeven grains of a looſe, pale-blueiſh precipitate, which turned black on expoſure to a red-heat. This precipitate, when fuſed upon charcoal, imparted to the glaſs-globule produced by the vitrification of a phoſphoric neutral ſalt, as well as to that which is obtained in the ſame manner from borax, a pure ſappharine blue colour. Its remaining part, that had not been employed for theſe experiments, yielded, upon ſolution in dilute muriatic acid, a ſympathetic ink; the traces of which directly aſſumed a yellowiſh-green colour on warming the paper, but diſappeared again as the paper cooled.

LXXII.

LXXII.

CHEMICAL EXAMINATION

OF THE

MINERAL SPRINGS AT IMNAU[*],

In SUABIA.

AMONG the many various *mineral waters* with which beneficent Nature has provided ſeveral parts of *Germany*, there are ſome which, by accident and good fortune, have acquired fame and credit; while others, on the contrary, though not leſs valuable, have either continued to be totally unknown, or have undeſervedly fallen into neglect and oblivion.

To theſe latter belong the *mineral-ſprings* at *Imnau*, a borough in *Suabia*, ſituated between *Tübingen* and *Rothweil*, in the eſtate *Haigerloch*, which is the property of *Prince Hohenzollern-Sigmaringen*.

Although theſe ſprings had been famous as early as the times of *Taberna-montanus*, I have not yet ſeen of them any account earlier than that given by *Caſpar*[†]. But how little ſatisfactory his information can be with regard to the nature and conſtituent parts of the water, may be concluded even from the date of its publication; as, in general, at that time a well-founded chemical analyſis of water could not even be thought of.

---

[*] *Chemiſche Annalen*, I. Band. page 1792,. 333.

[†] *Beſchreibung des Saeurbrunnens zu Imnau*, &c. durch Sam. *Caſpar*. Med. Dr. und Phyſicus zu *Sulz* am *Neckar*. Ulm. 1733, 8vo.

By the care of *Dr. Mezler*, phyſician to the Court of Hohenzollern-Sigmaringen, I obtained, of the mineral-water at Imnau, a quantity ſufficient for examination, in five well-ſtopped, and numbered bottles; the waters of which were taken from as many contiguous ſprings, flowing into one common reſervoir.

When the water arrived at Berlin it was found bright and clear; it frothed ſtrongly on being poured into glaſſes, and had an agreeable and ſtrong taſte of carbonic acid. From this deſcription only the water from the ſprings 4 and 5 ought to be excepted; becauſe, with reſpect to ſmell, as well as taſte, it ſeemed to be impregnated with ſulphurated hydrogen-gas.

Each of the waters contained in thoſe bottles I have firſt previouſly tried by means of *re-agents*. They were then ſubjected to analytical examination, in order to produce their conſtituent parts in a ſeparate ſtate.

A.

Examination by means of Re-agents.

I. *Tincture of Litmus.*

a) The *crude* water of all the five bottles, acquired by the tincture of litmus, a fine red colour.

b) When it had been *reduced* to one half *by boiling*, and filtered, it continued blue, on the addition of that tincture.

II. *Paper tinged with a decoction of Braſil-wood.*

a) The colour of the *crude* water changed the red colour of the paper to a violet.

b) *Boiled* water produced no change in the colour of that paper.

III. *Lime-water.*

On mixing equal parts of lime-water, and the water from each bottle ſeparately, the mixture was rendered cloudy and of a milk-white; but it rapidly became again clear.—However, by the addition of more lime-water, a quantity of carbonated lime fell down.

IV. *Concentrated Mineral Acids*

diſengaged from the water of each bottle numerous air-bubbles.

V. *Carbonat of Ammoniac, and Carbonat of Soda,*

produced a precipitate, which was thrown down entirely white, from the waters of the 1, 2, and 3 bottles; but that of the 4 and 5 bottles had an aſh-grey colour.

VI. *Cauſtic Ammoniac, and cauſtic Soda,*

yielded the ſame precipitates as at V. but in a leſs quantity.

VII. *Spirituous Tincture of Nut-galls.*

The water of the bottle, No. 1, ſuffered no change from it, except that it acquired a weak yellowiſh ſhade. But in the waters of the bottles marked 2, 3, 4, and 5, a purple precipitate was thrown down by this tincture, and the ſupernatant liquor acquired a violet colour, inclining to the green.

VIII. *Oxalic Acid*

immediately effected a copious precipitation.

IX. *Murial of Barytes*

produced a precipitate in but a moderate quantity.

X. *Sulphat of Magneſia*

a) Threw down from the rough water, after 24 hours, a precipitate ſufficient to be obſervable.

b) But the boiled water, combined with the ſame ſalt, was not rendered turbid, and it continued clear.

XI. *Nitrat of Silver.*

The water of bottle 1 continued at firſt unaltered, but afterwards it became a little opaleſcent. Thoſe of the bottles No. 2 and 3 were altered very little; they, however, acquired a browniſh tinge. The waters of bottles 4 and 5 were immediately rendered blackiſh, and depoſited a black ſediment.

XII. *Acetate of Lead.*

In the waters of the bottles 1, 2, and 3, it produced a white, and in thoſe of the bottles 4 and 5 a dirty, light-brown ſediment.

XIII. *Running Mercury,*

preſerved in the waters of the bottles 1, 2, and 3, its bright luſtre; but it became tarniſhed of a blackiſh hue, when immerſed into the waters taken from the 4th and 5th bottles.

XIV. *Leaf of beaten Silver.*

Small pieces of this continued unchanged in the waters of the 1, 2, and 3 bottles; but in thoſe of the 4th and 5th they became tarniſhed, firſt of a gold, and then of a copper-colour.

B.

Analytical Examination.

As a detailed explanation of every ſeparate experiment would occaſion unneceſſary repetitions; to avoid theſe, I ſhall relate only, in a few words, the method which I purſued in theſe reſearches. To this I ſhall add, in a ſummary way, the conſtituent parts which I have diſcovered in the water of each particular ſpring, together with their proportion to each other.

I. *Examination of the gaſeous conſtituent part.*

It has already reſulted from the preceding reſearches, that this mineral water is richly impregnated with carbonic acid gas. To aſcertain the quantity of this gas, its extrication and collection were performed by means of the mercurial pneumatic apparatus.

On examining the waters taken from the bottles No. 4 and 5, the mercury in the cylinder became incruſtrated, at its ſurface with a brown pellicle, during the operation; id not take place with the waters of No. 1, 2,

gas, that was diſengaged from the water of each as totally abſorbed by lime-water, and produced of lime. But in the common air, that occupied left in the retort after the introduction of the mi-ter, and which was driven over along with the acid gas, I could not diſcover any extraneous

xamination of the fixed conſtituent parts.

e hundred cubic inches of water (reckoning the of water, filling the capacity of *one* cubic inch, 290 grains of diſtilled water), from each ſpring ſe-, were evaporated at a moderate temperature in a h. The water
of the bottle No. 1, left 31¾ grains
. . . . . . 2, . 34½
. . . . . . 3, . 36¼
. . . . . . 4, . 39¾
. . . . . . 5, . 38
reſidue. That of No. 1 had a white, thoſe of No. a light reddiſh-grey, and thoſe of No. 4 and 5 a colour, of a little deeper caſt.

ll theſe reſidues were firſt treated with alkohol, 24 hours. The ardent ſpirit became imbued with yellowiſh colour, and when ſeparated by filtration, porated, it left behind it ſo ſlight a portion of a maſs, that its farther decompoſition was not well able. For this reaſon I collected it, by means of l, into one maſs, from all the five evaporating-diſhes, er having ſuffered the ſpirit again to exhale, I obtained

a reſidue

a reſidue weighing four grains. When this reſidue had been re-diſſolved in very little alkohol, there remained 1½ grain of *muriated ſoda:* and on combining the ſpirituous ſolution with ſulphuric acid, 1½ grain of *reſinous matter* was ſeparated. But the ſulphuric ſolution yielded ſulphat of magneſia; for which one grain of *muriated magneſia* may be put in the computation.

c) After this extraction of the ſeveral reſidues, by means of ardent ſpirit, I affuſed water upon each of them ſeparately, and agitated the mixture ſeveral times. After 24 hours the aqueous extracts were, by means of the filter, ſeparated from the undiſſolved portion, and made to cryſtallize: firſt, with the aſſiſtance of a gentle heat, and then by ſpontaneous exhalation in the open air. Every one ſhot into priſmatic cryſtals, which conſiſted merely of *ſulphated magneſia*; with the exception of that which had been obtained from No. 1, and which alone was accompanied with a nearly unobſervable trace of *ſelenite*, or gypſum. Theſe ſaline lixivia left at laſt a brown moiſture behind, which hardly amounted to a few drops, and contained ſo ſmall a quantity of *gummous-extractive* matter, that it could not be eſtimated.

d) Upon the portion that remained undiſſolved in water, I poured alkohol, and afterwards I dropped nitro-muriatic acid into it, until all efferveſcence and action of the acid ceaſed. On this proceſs a ſmall quantity of a muddy reſidue remained behind; which, when collected upon the filter, and ignited, left *ſiliceous earth* behind it.

All theſe ſolutions, previouſly filtered, were ſaturated with cauſtic ammoniac. By this combination, an hardly obſervable turbidneſs was produced in the ſolution of the reſidue left from the water of the bottle No. 1. But in thoſe of the other *four* reſidues a ferruginous precipitate enſued;

ich was carefully collected upon the filter, then waſhed,
ed, ignited, and weighed. This I diſſolved again in
ro-muriatic acid, in order to ſeparate a ſmall portion
ſiliceous earth; which ſtill has been mixed with it, and was
erwards collected, ignited, and weighed, for the purpoſe
aſcertaining the true weight of the iron, which the
eceding precipitate had contained, by ſubtracting the
ight of the ſilex from the whole weight of the former.
ter which, this portion of iron was reduced, in the com-
tation, to a correſponding quantity of *carbonated oxyd of*
n.

e) After having thus ſeparated the ferruginous part, I
luced the ſolutions, in ſome degree, by evaporation; I com-
ned them with a fourth part of their volume of alkohol,
ding, then, concentrated ſulphuric acid by drops, which
mediately threw down a quantity of ſelenite. I conti-
ed dropping in the acid, as long as any of this ſulphat of
ne would fall down. The ſelenite was collected on the
er, and when it had been edulcorated with a mixture of
ter and alkohol, I again decompoſed it, by boiling with
aqueous ſolution of carbonated ſoda. The *carbonat of*
te, thus ſeparated, was waſhed, dried, and weighed.

f) To diſcover whether the fluid remaining from the
arated gypſum contained any magneſia, I evaporated it
ſome part, and combined it with carbonat of ſoda, at the
gree of boiling heat. However, no precipitation took
ce.

According to the reſults of theſe inquiries, *one hundred*
bic inches of the waters of the *mineral ſprings* at *Imnau*
tain:

I.

I. *Water from the Bottle No.* 1.

Sulphat of magneſia, with a trace of *ſelenite*	5,75	grains
Muriat of ſoda	0,30	
Muriat of magneſia	0,20	
Carbonat of lime	25	
Silex	1	
Reſinous matter	0,30	
	32,55	grains

Carbonic acid gas, 104 cubic inches.

II. *Water from the Bottle No.* 2.

Sulphat of magneſia	5	grains
Muriat of ſoda	0,30	
Muriat of magneſia	0,20	
Carbonat of lime	27,75	
Carbonated oxyd of iron	0,75	
Silex	1	
Reſinous matter	0,30	
	35,30	grains

Carbonic acid gas, 105 cubic inches.

III. *Water from the Bottle No.* 3.

Sulphat of magneſia	5,50	grains
Muriat of ſoda	0,30	
Muriat of magneſia	0,20	
Carbonat of lime	28,25	
Carbonated oxyd of iron	1	
Silex	1	
Reſinous matter	0,30	
	36,55	grains

Carbonic acid gas, 104 cubic inches.

IV. *Water from the Bottle No.* 4.

Sulphat of magneſia . . .	6	grains
Muriat of ſoda	0,30	
Muriat of magneſia . . .	0,20	
Carbonat of lime	31	
Carbonated oxyd of iron . .	1,50	
Silex	1	
Reſinous matter	0,30	
	40,30	grains

Carbonic acid gas, 112 cubic inches.

V. *Water from the Bottle No.* 5.

Sulphat of magneſia . . .	5,75	grains
Muriat of ſoda	0,30	
Muriat of magneſia . . .	0,20	
Carbonat of lime	29,75	
Carbonated oxyd of iron .	1,50	
Silex	1	
Reſinous matter	0,30	
	38,80	grains

Carbonic acid gas, 115 cubic inches.

will be obſerved, that the ſum of the ſeparate conſtituent , in each of the above *five* computations, is a little greater the weight of the entire dry reſidue, that has been at firſt ined (B. No. 2. *a*.). This is to be accounted for by water of cryſtallization, which enters into the ſulphat agneſia.

C.

In this ſummary ſtatement will be found wanting the *ſulphurated hydrogen gas*, ſuſpected before in the waters of the 4th and 5th bottle, or ſpring (page 581); the preſence of which, however, ſeemed to be indicated by their taſte and ſmell, as well as by the dark colour of the precipitate thrown down by acetated lead, and by the tarniſhing of the reguline mercury and ſilver-leaf (A. No. 13 and 14), immerſed into them.

However, ſince I have experienced in other inſtances, that, in mineral waters, theſe and ſimilar indications originate but rarely from real ſulphurated hydrogen gas, and that more frequently they ariſe from the admixture of putreſying organic matters; I entertained a doubt: whether that putrid vapour be an eſſential ingredient in the waters of the ſprings No. 4 and 5? Of this doubt I informed Dr. *Mezler*, requeſting him to examine this object on the ſpot. And it reſulted from the reſearches, which he made, that this ſmell, reſembling that of ſulphurated hydrogen gas, was owing merely to the putreſcent ſtate of a cement, which had been employed in the conſtruction of ſome pipes, through which it was found neceſſary to force the water of the *fourth* and *fifth* ſprings into their appropriate reſervoirs. This cauſe has been ſince removed; hence theſe ſprings are, at preſent, entirely free from all extraneous contamination. When the whole of the water had been pumped out of the reſervoirs, and, conſequently, when Dr. *Mezler* was enabled to examine water, that had recently iſſued from theſe ſprings, he found, neither by the taſte nor by the ſmell, the leaſt trace of that hepatic odour. Beſides this, he filled, under the ſurface of the water, four bottles; the *firſt* of which contained ſome clear pieces of white arſenic; the *ſecond*, ſome cryſtals of purified acetate of lead; the *third*, beaten leaf-ſilver; and the *fourth*, running mercury: ſtopping all theſe bottles cloſely. After 24 hours, the arſenic was found as white as before; the precipitate produced by the acetated lead was of a beautiful white; and the metallic luſtre of the ſilver and mercury was not in the leaſt impaired.

END.

ERRATA.

Line			
20	*effect*	read	effect.
31	36		35
8	122		112
13	$160\frac{5}{8}$		$160\frac{7}{8}$
22	2 5		$2\frac{2}{5}$
17	5—7		15. 1. 7.
8	*1 grain.*		$1\frac{1}{4}$ grain.
29.30	*would ſhoot*		would not ſhoot.
18	*carbonic*		muriatic.
14	2,40,0		2,490
1	*carbonated free ſoda*		cauſtic ſoda.
16	47 *lb.*		47 grains.
6	*muriatic*		ſulphuric
8	after *leucite*, read, whoſe earthy parts, like thoſe of lepidolite, are alſo ſilex and alumine, &c.		
12	*ſulphuric*		ſulphureous.
24	*muriatic*		ſulphuric.

ANALYTICAL ESSAYS TOWARDS PROMOTING THE CHEMICAL KNOWLEDGE OF MINERAL SUBSTANCES.

BY MARTIN HENRY KLAPROTH,

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VOL. II.

TRANSLATED FROM THE GERMAN.

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1804.

NOTICE.

THE ſmall volume which is here offered to the friends of the higher branches of Chemiſtry, contains the new ſeries of Klaproth's Analytical Eſſays towards promoting the chemical knowledge of foſſils. *The celebrated author has prefixed no preface to the German original, and the Tranſlator did not think it proper to add one of his own. So valuable a work is above receiving an additional luſtre by ſuch interference, and Klaproth's reputation is ſufficiently eſtabliſhed in England, as well as on the Continent.—But the Engliſh reader, on peruſing theſe Eſſays, will appreciate the important diſcoveries made by the author. He will trace with pleaſure the eaſy means by which they were made, and with ſatisfaction perceive the dexterity and ſkill uſed in conducting the experiments deſcribed in theſe Eſſays.—Surprized, on the one hand, at the accuracy of the reſults, he will, on the other, admire the candour and modeſty with which they are ſtated, as well as the juſtice which this eminent Chemiſt renders to the merits of other fellow-labourers in Science.—From very few other*

lucubra-

NOTICE.

cubrations, perhaps from none, ſo much practical
nowledge of chemical analyſis may be obtained,
from the ſtudy of Klaproth's method. Whence
is hoped, this ſecond *volume of his Analytical*
ſſays, &c. deſerves the ſame kind patronage with
hich the firſt *has been received. Thoſe who long*
iſhed and called for this tranſlation, will give
ave to apologize for the involuntary delay in pub-
ſhing it: and, in general, the reader's indul-
ence is requeſted with regard to a few errors of
he feather and print, the more notable of which
re indicated at the end.

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LXXIII.

CHEMICAL EXAMINATION

OF THE

AURIFEROUS ORES,

FROM

TRANSYLVANIA *.

ONG the various products of the mineral kingdom which Nature has filled the ſubterraneous parts of ſylvania, thoſe foſſils deſerve the particular attention of aturaliſt which are known by the name of *white gold-* d *grey gold-ore* †.

moſt all what hitherto has with certainty been known eſe minerals, is that they contain *gold* and *ſilver* in us proportions: but the chemical knowledge of the conſtituent parts of them continued involved in doubt ncertainty.

---

ead in the public ſitting of the Royal Academy of Sciences lin: 25th January, 1798.

circumſtantial account of the places where theſe foſſils of the manner by which they are obtained, and of their ex- characters is found in the excellent *phyſical and mineralogi- ſcription of the gold and ſilver mines near Nagy-ag*, by Mr. in the new Memoirs of the Society of Naturaliſts at Berlin. I. 1799, page 1, ſeq.———See alſo *Eſmark*'s Deſcription ineralogical Journey through Hungary, Tranſylvania, and nnat in the *Neuen bergmänniſchen Journal.* Vol. I, num- nd 6. Vol. II. number 1 and 2.

XCV. Examination of the Mari
XCVI. ——— Phoſphat
XCVII. ——— Kryolit
XCVIII. ——— Beryl
XCIX. ——— Em
C. Examination of Kl
CI. ———
CII. ———
CIII. Addition to th
(Eſſay 31)
CIV. Examination
Norway
CV. Examin
CVI. ———
CVII. ———
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CIX. ———
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CXI. E
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CXVI.

of the mineralogy, with theſe coſtly ſts in the diſcovery the name TELLU- old mother *earth*.

ly the *chief conſtituent*, of thoſe minerals, I ination *ores of tellurium*, ſpecies.

I.

Tellurium.

to which I appropriate this giſts have hitherto called *aurum* *lematicum*, from the mine *Ma-* tains near *Zalathna* in Tran- this ore is intermediate between : and it frequently has a red- nt on its ſurface. It poſſeſſes When it occurs maſſive, which it is an aggregate of cryſtalline ; commonly of but ſmall and ted in a ſtony matrix mixed of

giſts could never before agree with of the metal contained in this ore; biſmuth, and others for antimony.

the truth, *Mr. Müller*, then coun- in *Hermannſtadt*, and afterwards di- of the mines in Zalathna, has already in the year 1782.

82, ſubjected this ore to a chemical examination; the mi-
ıte deſcription of which is contained in the *phyſical labours*
united friends at Vienna, collected by *Born*. However,
nce the reſults of Mr. Müller's experiments gave no indi-
tion of biſmuth, nor of antimony, he was induced to ſuſ-
ct in it a new metal. Yet the confirmation of this con-
cture, or the deciſion of the queſtion: whether this pro-
ematic ore be really a peculiar new metal or not? he left
the celebrated *Torbern Bergmann*. But even this learned
hemiſt has not totally ſolved it. What he ſaid on this
oint, conſiſts merely in this: that according to his expe-
iments, this metallic ſubſtance is of a different nature from
ntimony; but, at the ſame time, that he does not venture
give a decided opinion on it.

The mineralogical public has ever ſince in vain expected
more accurate determination and chemical knowledge of
his foſſil: nay, its increaſing rarity ſeemed almoſt en-
irely to do away all hope of a future analyſis of it.

Hence ſo much the greater praiſe is due to that zeal for
cience, which has induced ſeveral of my mineralogical
riends, and in particular Mr. *Müller de Reichenſtein*, to
nable me, by a portion of this mineral, to continue the
hemical labours ſo admirably well begun by the laſt men-
oned learned metallurgiſt; to confirm the exiſtence of the
ew metal which he ſuſpected in that foſſil; and to exhibit
is metal by itſelf, as well as to eſtabliſh ſeveral of its che-
ical properties.

I. *Analyſis of the native Tellurium.*

The manner in which I proceeded in decompoſing this
, and in educing its conſtituent parts, is the following.

1) The crude ore, ſeparated from its matrix as much as poſſible, is mechanically divided, and ſix parts of *muriatic* acid are poured upon it; the whole is then warmed in a ſand bath, and *three* parts of nitric acid are added by degrees: when, on each addition, a violent action takes place. By this means the metallic portion of the ore becomes entirely diſſolved, leaving only the matrix, for the greateſt part conſiſting in ſmall grains of quarz, behind.

2) In the next place, the filtered ſolution is carefully diluted with as much water, as it will bear without being rendered turbid. And upon this it is combined with *cauſtic* potaſh or ſoda, until the white precipitate thereby produced diſappears ſo far, that only a dark-brown ſlimy reſidue remains.

3) This reſidue conſiſts of *iron* and *gold*. To ſeparate the latter, this reſidue muſt be re-diſſolved in *nitro-muriatic* acid, and the gold precipitated from that ſolution by liquid nitrate of mercury prepared in the cold: adding this gradually, until the precipitate which it forms appears no longer brown but white. The precipitate carefully collected is then expoſed to a red heat, and fuſed with borax to a bead of fine gold.

4) After the gold has thus been ſeparated, the reſidual ſolution of iron is precipitated by means of *cauſtic* potaſh or ſoda; the oxyd of iron is ignited, and afterwards reduced to reguline or metallic iron.

5) Laſtly, for the purpoſe of obtaining the tellurium, the alkaline ſolution of the ore, being freed from the gold and iron, is to be neutralized with *muriatic acid:* moſt accurately obſerving the point of ſaturation. In this inſtance [illegible] white precipitate enſues, which in a raiſed temperature

ure falls to the bottom in the form of a heavy powder.— is then collected, waſhed with a mixture of equal parts water and ſpirit of wine, and dried in a gentle warmth.

6) To reduce this oxyd of tellurium, it ſhould previouſly moiſtened with a fat oil, then put into a ſmall glaſs rert, to which a receiver is luted, and with a moderately creaſed heat, brought to the ſtate of ignition.—After the l has been converted into a coal, the upper part of the rert is ſeen,—nearly ſo as in the diſtillation of mercury— be lined with reſplendent ſmall metallic drops, which ain glide down ſeparately, and make room to new ſuceding ones. Upon refrigeration the reduced metal,— ith the exception of ſuch of theſe metallic drops as adhered the ſhoulder of the retort, and became there fixed,—is und fuſed, of a clean, ſplendent, and alſo moſt frequently a cryſtalline ſurface.

But the metallic oxyd, the reduction of which is aimed , ſhould but moderately be moiſtened with oil, to avoid e generation of a ſuperabundant coaly reſiduum, which events the reduced metallic globules from uniting into e maſs.

Inſtead of the oil, pulverized charcoal alſo ſerves, and is ther fitter for this purpoſe: but this alſo muſt be employed ly in a proportionate quantity. If eight or nine parts of arcoal-powder be uſed for a 100 parts of the telluric oxyd, complete reduction is effected, in which neither any part the oxyd, nor of the coal remains. In the very moment, at the reduction takes place, a quantity of carbonic acid s is ſuddenly generated: carrying over along with itſelf me pulverulent particles of the mixture, which it depoſites the receiver.

The reduction of tellurium, if to be effected without loſs, ſucceeds only when, in the manner here explained, it is performed in a ſmall retort of glaſs. In an experiment, in which the telluric oxyd was put into an aſſay-crucible lined with charcoal, having its lid well luted on, and placed in the furnace, the flame of the coal had a ſky-blue colour, and after cooling the whole was found to have entirely eſcaped.

Of the granular telluric ore, which furniſhed the object of this inquiry, the metal tellurium forms the *principal* conſtituent part. A certain portion of a maſſive variety of it, dug about the year 1780, was attenuated by trituration; and 100 grains of it extracted by means of acids, until the quarzy matrix, which weighed 11½ grains, remained.

Agreeably to this previous experiment, *one thouſand one hundred and thirty grains* of the ſame powdered ore were extracted by means of the muriatic and nitric acids, according to the method related above. The reſidue, which conſiſted of ſmall grains of quarz, weighed after ignition 130 grains. Hence, exactly 1000 grains of the ore had been diſſolved; and theſe conſiſted of

Tellurium	925,50
Iron	72
Gold	2,50
	1000 grains.

Experience, however, has ſhewn to me that the proportion of gold in this foſſil is variable, as it is in general in all the auriferous minerals of Tranſylvania. In ſeveral ſubſequent experiments I found the foſſil here examined to contain *gold* in greater proportions; ſo that in a certain variety of the *native tellurium*, the gold amounted nearly to 9 parts in the hundred.

Of the experiments made in the *dry way* with this ſubſtance, I ſhall ſelect only a few.

1) *One hundred* grains of *native tellurium*, mixed with 250 grains of *nitre*, and projected into an ignited crucible, did not detonate; but the metallic tellurium immediately fuſed, underneath the quietly melting nitre, in the form of grains which ſoon united into a button.

2) 100 grains of *native tellurium* mixed with 40 grains of *ſulphur*, and 420 grains of *nitre* were by degrees thrown into a red-hot crucible. Each introduced portion immediately inflamed with a dazzling white light, and the mixture readily entered into a thin fuſion. After it had been left in the fire for a ſhort while longer, during which time it continued boiling, it was taken out: upon which it indurated to a dark brown maſs. When ſoftened with water and filtered, a brown oxyd of iron mixed with ſome gold remained on the filter, together with the quarzoſe matrix. The filtered fluid was colourleſs. On being ſaturated with *ſulphuric acid*, a white oxyd of tellurium ſeparated; but which would not again clearly diſſolve on adding an exceſs of the acid, and was then precipitated by carbonated ſoda. This method, therefore, is applicable for the purpoſe of obtaining directly a pure telluric oxyd: but it is attended with ſome loſs of the latter.

II. *Of ſome principal properties of Tellurium.*

1) The colour of pure tellurium, in the reguline ſtate,

is a *tin-white, verging into the lead-grey.* It has a very high metallic ſplendour. Its fracture is of the ſtraight foliated kind, and the ſurfaces of its fragments are very brilliant. When cooling undiſturbed after fuſion, it aſſumes a cryſtalline ſurface. It is very brittle, and readily pulverizable.

2) Among all the known fuſible metals, tellurium poſſeſſes the *leaſt ſpecific gravity*, which to that of water is only as 6,185 to 1,000.

3) Tellurium belongs to the *metals of eaſy fuſion*, or in other words, to thoſe which fuſe before ignition.—At the ſame degree of heat it melted later than lead, but ſooner than antimony.

4) Upon charcoal, before the blow-pipe, it *inflames* with a violence reſembling detonation, with a vivid, light-blue and on the edges greeniſh flame, and entirely flies off in vapours of the appearance of a grey white ſmoke; which inveſts the charcoal in the moſt contiguous places with a white, but the remoter ones with a bluiſh coating, and is alſo particularly diſtinguiſhed by the ſomewhat nauſeous *radiſh-like ſmell* which it emits. If the blowing be diſcontinued, before the whole of the metal is vaporized, the ſurface of the remaining metallic globule, which continues fluid for a conſiderable time, congeals with a dendritical and ſtriated appearance, and commonly acquires a tarniſh of variegated colours like the peacock's tail.

5) By *mercury* the metallic tellurium ſeems to be but *weakly attracted.*—*One* part of it, rendered fluid with a gentle heat in a crucible, formed no perfect amalgam with *five* parts of mercury, but only a mingled maſs of detached mercurial globules, and re-indurated grains of tellurium.

One

ne part of tellurium in powder heated upon charcoal-
in a ſmall glaſs-retort, with *ſix* parts of mercury, ap-
ed after refrigeration to have united into an amalgam
. cryſtalline ſurface. But it was found, that the mer-
r had taken up little or nothing of the tellurium; and
the latter had only covered the ſurface of the former
he form of minute ſcales.

) When fuſed in a gentle heat with an equal quantity
ulphur, it forms a lead-coloured, ſtriated mineralization.
his compound be heated to ignition in a ſmall retort, part
he ſulphur becomes ſublimed, and ſettles in the neck of
retort as a compact black-brown maſs. A little of this
on fire upon a cold piece of charcoal, burned quietly
h a greeniſh flame, and left upon the coal a thin me-
ic coating behind. At the bottom of the retort the ſul-
rated tellurium appeared as a ſteel-grey, only half fuſed,
ous maſs of a moderately metallic ſplendour.

) With *nitric acid* the tellurium yields a limpid, colour-
ſolution, which is not rendered turbid by water. In
concentrated ſolution there are found, after ſome time,
te, very ſlender, light, needle-ſhaped cryſtals, which
nmonly form a dendritic aggregate.

) *Muriatic* acid, on the addition of a little nitric acid,
rds a ſimilar clear ſolution of this metal. This ſaturated
tion is decompoſed by dilution with water, and the tel-
c oxyd falls down in the ſtate of a white powder, but is
in almoſt entirely diſſolved upon repeated affuſions of
e water.—If on the contrary the concentrated ſolution
liluted with ſpirit of wine inſtead of water, and if the
cipitate, which is produced, be edulcorated with the
e mixed fluid, little telluric oxyd or none at all remains
he ſolution. However, ſuch precipitate obtained merely
by

by means of water or ardent ſpirit, muſt not be conſidered as a pure oxyd of tellurium, ſince it is ſtill combined with a ſmall quantity of muriatic acid.

9) If upon a ſmall portion of tellurium one *hundred* times its weight of *concentrated ſulphuric acid* be poured in a cloſed veſſel of glaſs, without heat, the acid gradually acquires a tinge of a fine, deep amethyſtine red. On the addition of water, this colour diſappears, and the ſmall quantity of the metal diſſolved ſeparates in the form of black flocks. Heat, likewiſe, deſtroys this red colour of the ſolution, and the diſſolved portion of the metal is precipitated as a white oxyd.

10) On the contrary, when the *ſulphuric acid* is previouſly diluted with 2 or 3 parts of water and combined with ſome drops of nitric acid, it diſſolves a larger portion of the metal. The ſolution has neither any colour, nor is it decompoſed on the addition of water.

11) *Alkaline ſalts* precipitate the telluric oxyd from its acid ſolutions of a white colour, and the precipitate is again ſoluble in all acids without the neceſſity of adding nitric acid. If in ſuch precipitation a greater proportion of alkaline ſalt be uſed than is requiſite for the neutralization of the acid, the precipitate is again entirely diſſolved by the carbonated as well as cauſtic alkalis.

Hundred grains of tellurium were diſſolved firſt in nitro-muriatic acid, and then in liquid cauſtic pot-aſh or ſoda, and from this laſt ſolution again precipitated by muriatic acid: moſt carefully obſerving the point of ſaturation. The telluric oxyd thus obtained, having been waſhed with a mixture of water and ſpirit of wine, and dried in a low heat, weighed 120 grains.

12) The acid ſolutions of this metal are not at all precipitated nor rendered turbid by treatment with *pure Pruſſian alkali:* a remarkable property of tellurium, which, however, it poſſeſſes in common with gold, platina and antimony.—But in theſe experiments as well as in the following, it is neceſſary to ſuper-ſaturate the ſolutions with a little exceſs of the acids, in order that they may be diluted with 4 or 6 parts of water without being rendered turbid.

13) By *alkaline ſulphurets* tellurium is thrown down of a brown or blackiſh hue, according to the greater or leſs degree of its ſaturation with oxygen. Such ſulphurated precipitate, when placed upon charcoal after deſiccation, burns with a pale-blue flame as already mentioned, and both the ſulphur and the metal are conſumed at the ſame time.

14) *Tincture of galls* produces a flocculent, iſabella-yellow precipitate.

15) *Zinc* and *iron* precipitate the tellurium from its ſolution in acids in the metallic ſtate, in the ſhape of blackiſh flocks, which by trituration acquire a metallic luſtre. Theſe, heated with the blow-pipe, upon charcoal, directly unite into metallic globules, emitting a white-grey vapour, and burning with the mentioned light-blue flame of a greeniſh caſt on the exteriour parts. *Tin* and *antimony* reduce it in the ſame manner to the reguline ſtate from its ſolution in the muriatic acid. Its precipitation by the latter yields, beſides other arguments, one of the moſt evident proofs, that this new metal is not diſguiſed antimony as once has been imagined. *Phoſphorus*, if put into a muriatic ſolution of tellurium, is gradually coated with metallic laminæ.

16) Oxyd of Tellurium heated upon charcoal with the blow-pipe, is reduced with a ſomewhat vehement efferveſcence, ſpeedily converted into vapours and conſumed by burning. But, on the contrary, if heated in a ſmall glaſs-retort, it fuſes, and upon refrigeration exhibits a ſtraw-yellow colour and ſtriated texture.

The conſideration of theſe chemical properties, I imagine, may be fully ſufficient to eſtabliſh this foſſil as a peculiar, diſtinct metal, eſſentially different from every other metallic ſubſtance hitherto known. But as ſeveral of theſe properties have already been noticed in the crude foſſil, and ſtated to the Public by Mr. *Muller*; it is to him that the merit belongs both of having firſt ſuſpected in it a new diſtinct metal, and of having rendered its exiſtence probable.

B.

Aurum Graphicum. (Schrifterz.)

Among the Tranſylvanian *white gold-ores*, as they are called, is the *Aurum graphicum*, from the mine *Franciſcus*, at *Offenbanya*, particularly diſtinguiſhed as a ſeparate ſpecies of the ore of tellurium; not only by its external characters, but alſo by the larger proportion of gold which it contains.

Its colour is a tin white with a ſhade of braſs-yellow. It poſſeſſes a ſtrong metallic luſtre, and is moſt frequently compoſed of compreſſed, flat, priſmatic cryſtals; which commonly by their oppoſite directions, exhibit a delineation reſembling Turkiſh letters, and thus gave riſe to its denomination of *aurum graphicum.* It generally occurs in thin layers upon a grey quarz, in the clefts and fiſſures of a bluiſh-grey argillaceous porphyry, in which lithomarga is diſſeminated.

As the pure cryſtals of this ore are but ſparingly interſperſed, I could not obtain more than 15 grains from ſeveral ſpecimens, notwithſtanding that I was very careful in collecting them.

1) *Five* grains of thoſe cryſtals previouſly reduced to powder were expoſed to the action of the blow-pipe in a cavity made in a charcoal. In the moment they came in contact with the point of the flame, they began to evaporate with the phenomena peculiar to tellurium, and left a metallic globule behind, which, on being re-melted with a little nitrate of potaſh, weighed 2 grains. This globule when alloyed with 5 grains of ſilver, and refined in the uſual way of quartation by means of nitric acid, yielded *one* and *a half grain* of *gold*. The ſilver precipitated from the nitric ſolution by copper, has acquired ½ grain of additional weight.

2) The other *ten* grains of thoſe pure cryſtals when diſſolved in *nitro-muriatic* acid, left muriate of ſilver behind, the quantity of which was equivalent to one grain of reguline ſilver. From this ſolution the telluric oxyd was ſeparated by affuſing a mixture of water and ardent ſpirit: and, when the oyxd had been collected, the *gold* was precipitated by ſulphate of iron. Its weight after ignition amounted to full *three grains*.

3) In various places of the ſtony matter, from which theſe cryſtals have been ſeparated, I found more of them very finely interſperſed. Such richer parts of the foſſil were ſelected, ground fine, by elutriation ſeparated from the lighter foreign matters and thus brought to a ſmaller compaſs. The

waſhed ore thus obtained equipoiſed 136 grains, and was examined in the way as follows.

a) It was not acted upon by the *muriatic* acid with which it was digeſted, until after the addition of nitric acid in ſmall portions. After it had been digeſted during a ſufficient time it was filtered, and the reſidue upon the paper elixiviated with water acidulated with muriatic acid. Its weight, after drying in a warm temperature, was 104 grains.

b) This reſidue, conſiſting of quartz, being heated in a ſmall crucible ſhewed no trace of any ſulphureous ingredient. I mixed it with five times its weight of carbonate of ſoda, and melted it. The refrigerated maſs, when diſſolved in water, left *three grains* of *ſilver* behind.

c) The ſolution a) together with the edulcorating fluid was concentrated by evaporation, and after this largely diluted with ſpirit of wine. By this management a white oxyd of tellurium immediately ſeparated; which, after the ſupernatant liquor had again become clear, was collected on the filter, waſhed with ardent ſpirit, and dried. Having been a-freſh diſſolved in muriatic acid, and the ſolution diluted with as much water as it would take up without becoming turbid, a poliſhed piece of iron was introduced. The *metallic tellurium*, precipitated in black flocks, weighed *nineteen* and *a half grains*.

d) The portion of *gold* contained in the remaining part of the ſolution, and the quantity of which, after ignition, amounted to *nine* and *a half grains*, was precipitated by diſſolved ſulphate of iron.

From this near agreement of the reſults of the three different methods of inveſtigation, we are allowed to conclude

de that the *aurum graphicum* contains in the *hun-*
d;

Reguline Tellurium	60
. . . . . Gold	30
. . . . . Silver	10
	100

C.

On the Yellow Auriferous-Ore. (Gelberz.)

The *yellow auriferous-ore* from *Nagyag*, which furniſhed
ſubject of the preſent analyſis, is of a ſilvery-white
our, verging into the braſs-yellow; occurs maſſive, or
coarſely diſſeminated; and is pervaded by quarz and
ro-calcite, *(Braunſpath)*.

) *Four hundred* grains of this ore, freed from its matrix
much as poſſible, were digeſted in a sand-heat with
ic acid, which attacked it with vehemence. The di-
tion being accompliſhed, the acid was decanted, and
undiſſolved reſidue again digeſted with a new portion
he ſame acid; but this would no more act upon it.

) The colourleſs ſolution, ſeparated from the reſidue
means of filtration, I combined with *muriatic acid* until
turbidity ceaſed. The white precipitate, left on the
r and dried had 51 grains of weight. On being boiled
h a large quantity of water it diſſolved, excepting 8
ins conſiſting in muriated ſilver, which, by reduction,
rded *ſix grains* of ſilver in the metallic ſtate.

) Thoſe 43 grains of the mentioned precipitate, which
in diſſolved b), ſhooted, on evaporating the liquor,
gradually

waſhed ore thus obtained equipoiſed 136 [illegible] were fou
examined in the way as follows. [illegible] s of regulin

a) It was not acted upon by the *muriat* [illegible]
it was digeſted, until after the additio [illegible] due, which was le
ſmall portions. After it had been [illegible] poured *muriatic acid*,
ficient time it was filtered, and the [illegible] faint greeniſh-yellow.
elixiviated with water acidulated w [illegible] this treatment, gave
weight, after drying in a warm [illegible] llic, reſplendent gold,
grains. [illegible] atrix: and it thus con-
[illegible] ture of theſe ores, the

b) This reſidue, conſiſting of [illegible] On the addition of a
ſmall crucible ſhewed no tra [illegible] diſſolved directly. The
dient. I mixed it with five [illegible] ated from the ſolution by
of ſoda, and melted it. Th [illegible]
ſolved in water, left *three* [illegible]
[illegible] with that nitric ſolution,

c) The ſolution a) tog [illegible] been obtained c), and re-
was concentrated by [illegible] ited muriate of lead; which
diluted with ſpirit of w [illegible] ately diluted muriatic acid
oxyd of tellurium imm [illegible] gh 11 grains, equivalent to 8
ſupernatant liquor h [illegible]
on the filter, waſhe [illegible]
ing been a-freſh diſ [illegible] of the concentrated ſolution c)
diluted with as mu [illegible] was added, to an exceſs of
becoming turbid, [illegible] brown precipitate fell down.
The *metallic tellu* [illegible]
nineteen and *a ha* [illegible] had been ſeparated from this

d) The porti [illegible] ed with *muriatic acid*, and
of the ſolution, [illegible] then formed, afreſh rediſſolved
amounted to *ni* [illegible] ſolution, mixed with ſuch a
ſolved ſulphate [illegible] be done without cauſing turbid-
[illegible] placed; by which a quantity of

From this [illegible] 55 grains, was thrown down
different meth [illegible] flocculent ſtate.

h) Upon

recipitate *f*), nitro-muriatic yellow ſolution. This was tity of pure or cauſtic pot-aſh, d but a little; and in the next of mercury, prepared in the cold, long as the gold, precipitated from is a brown colour. This precipitate e filter, waſhed and dried; upon which with its contents, was wrapped up and fire. After the paper had been burned away, was gradually introduced into the crucible nt to cover the gold, and the fire increaſed fuſion. The well melted globule of *gold* obtained by this proceſs amounted to 50 grains and ¾.

hat part of the ſolution which remained after the ion of the gold, was combined, in a heat of ebullition, firſt and as to the greateſt part with a cauſtic alkali, and afterwards completely neutralized with carbonated ſoda. The blackiſh precipitate thereby obtained, being previouſly edulcorated, was expoſed to a ſtrong red heat, and after this digeſted with boiling nitric acid. Only a ſmall portion of it ſeemed to diſſolve; but when a little ſugar was added a complete ſolution enſued.

k) Upon this nitrated fluid I poured ſulphuric acid and evaporated the mixture to a certain degree. During this evaporation, I perceived ſulphate of lime gradually ſhooting in needle-form cryſtals, which collected, waſhed with weak ſpirit of wine and deſiccated, gave 41 grains of weight. For theſe we muſt put to the account 26 grains of *carbonated lime*.

l) The remainder of the fluid was again diluted with water, and combined with carbonate of ſoda in a boiling heat;

heat. This addition produced a copious precipitate, upon waſhing and drying weighed 68 grains, an examination proved to be *carbonated oxyd of man* though with ſome admixture of iron and alumine.

m) The reſidual quarzy matter of *d*) weighe grains. When gently heated, a weak ſulphureous appeared: but its weight was diminiſhed only about 1 Upon this I mingled it with four times its quan carbonated pot-aſh, and brought the whole in a c to the ſtate of fuſion. After cooling it appeared as pact maſs of a pale amethyſt red, which, ſoftened in left a *ſilver* globule of 10⅛ grains of weight behind. fore, as this globule had exiſted in that reſidue in tl racter of muriated ſilver, on the account of whic grains muſt be ſubtracted from the above 120½ grai the ſame manner as for the ingredient *ſulphur* 1 grai be deducted; there remain after this ſubtraction, 106 for the quarzoſe matrix.

Whence, the educts obtained in this analyſis o *hundred grains* of the *yellow gold ore* mixed with its m are:

Tellurium	g)	. . . .	85.	grains
Gold	h)	. . . .	50. 75.	
Lead	c)	29	37.	
	e)	8		
Silver	b)	6	16. 125.	
	m)	10⅛		
Sulphur	m)		1.	
Carbonate of Manganeſe	l)	. . . .	68.	
——— *of Lime*	k)	. . . .	26.	
Quarz	m)	. . . .	106.	
			389 875	
Loſs			10 125	
			400	

However, ſince the *quarz*, *calcareous earth*, and *Manganeſe* belong only to the matrix of this ore; it follows hat, after deducting their amount from the whole matter mployed, the conſtituent parts of the pure *yellow ore*, here xamined, are to each other in the following proportion:

Tellurium	44. 75
Gold	26. 75
Lead	19. 50
Silver	8. 50
Sulphur	0. 50
	100

There occurs a *variety* of the *yellow ore* in ſomewhat broad radii, and of a lamellar texture and fracture, in a mingled aggregate of ſmall cryſtals of quarz, of red and black manganeſian ore, and alſo moſt frequently between the laminæ of the *gold-ore* from *Nagyag*. As to its conſtituent parts, it ſeems to agree with the preceding: but it was not eaſy to aſcertain their true proportion, becauſe it cannot be well ſeparated from the Nagyag ore which is very firmly concreted with it.

D.

Auriferous foliated ore from Nagyag. (Blättererz).

From the preceding three ores of tellurium, which were formerly comprehended under the name of white gold-ores, is diſtinguiſhed the *foliated auriferous ore from Nagyag*, both in a *chemical* and in a *mineralogical view*. For this reaſon alſo it has been introduced in the later ſyſtems of Mineralogy, as a diſtinct ſpecies belonging to the genus of gold, with the denomination *lamellar, or foliated grey gold-ore.*

any of them farther appeared. Theſe cryſtals, when collected, were carefully rinſed by dropping upon them muriatic acid, and highly dried. They weighed 330 grains equivalent to 248 grains of lead in the reguline ſtate.

e) After the concentrated ſolution had thus been freed from the lead, I diluted it a little with water, and added to it a large quantity of ſpirit of wine as long as any white precipitate enſued. The mixture having ſtood for a while in a gentle warmth, I collected that precipitate on the filter, edulcorated it with ardent ſpirit, re-diſſolved it in muriatic acid, and precipitated it again in the ſtate of a pure telluric oxyd, by means of cauſtic ſoda and by ſtrictly watching the preciſe point of ſaturation. This oxyd, waſhed and dried, gave on the ballance 178 grains, which correſpond with 148 grains of *reguline tellurium.*

f) For the purpoſe of aſcertaining the portion of gold, I now reduced the fluid, from which the tellurium had been ſeparated, by diſtilling off the ſpirit of wine in a retort; diluted again the concentrated ſolution with water; and, laſtly, dropped into it a nitric ſolution of mercury prepared without the aſſiſtance of heat; adding this nitrate until no brown precipitate appeared any farther, and till the white precipitate which ſucceeded the brown, no longer changed its own colour. After this the mixture was placed in a warm temperature; where the white precipitate, which was owing to the nitrated mercury added in exceſs, again gradually diſappeared. The brown precipitate, which fell to the bottom as a heavy powder, was the gold ſought for. When collected and fuſed with nitrate of pot-aſh, it gave a bead of *pure gold* weighing 41½ grains.

g) The liquor was now ſaturated with carbonated ſoda in a boiling heat. A copious bluiſh-grey precipitate enſued, which turned black-brown by ignition. Digeſted with *muriatic* acid it diſſolved again clearly, and gave out oxygenated muriatic acid gas. By combining this ſolution with liquid carbonate of ammonia to a conſiderable degree of ſuper-ſaturation, a greyiſh white precipitate was produced; which collected, waſhed and dried weighed 92 grains, and proved to be a ſomewhat iron-ſhot, carbonated *oxyd of manganeſe.*

h) The ammoniacal lixivium *g*) appeared of a blue colour. After being ſuperſaturated with ſulphuric acid, by which it was again rendered colourleſs, a ſmall plate of poliſhed iron was introduced, and the veſſel put in a warm place. The iron became gradually coated with *copper*, the weight of which after drying was *ſix grains.*

Therefore the 1000 grains of the *Nagyag foliated auriferous ore* employed in this analyſis, were decompoſed into:

Lead	d)	248	grains.
Tellurium	e)	148	
Gold	f)	41. 50	
Silver	c)	2. 50	
Copper	h)	6	
Sulphur	b)	14	
Oxyd of manganeſe	g)	92	
Quarz	c)	437	
		989	
	Loſs	11	
		1000	

But, ſince the two laſt mentioned articles belong merely to the matrix, which is a mixture of quarz and red manganeſian ore, and, therefore, cannot be reckoned among the conſtituted parts of the foſſil itſelf; it follows that the real proportion of its ingredients is:

Lead	54
Tellurium	32. 2
Gold	9
Silver	0. 5
Copper	1. 3
Sulphur	3
	100

II.

With a view of forming a preciſe eſtimate of the ingredient ſilver, 500 grains of the ſame foſſil were finely pulverized, for a ſufficient time digeſted in moderately ſtrong nitric acid, and the ſolution combined with diſſolved muriate of ſoda; by which it acquired a dilute milk-colour. Expoſed to a warm temperature it again became limpid and depoſited a white precipitate, which was muriated ſilver, and by reduction with proper care, yielded a bead of *fine ſilver* of the weight of 1¼ grain.

III.

Another portion of that lamellar auriferous ore from Nagyag, but concreted with a leſs quantity of the matrix than the former, I ſubjected to the *analyſis* in the *humid way*; merely with a view of diſcovering its contents in *gold* and *ſilver*.

Two hundred grains of it were digeſted with nitric acid, till no farther attack was perceived. The colourleſs ſolution obtained was neutralized with muriated ſoda, which produced a white precipitate; and after this it was diluted with more water and boiled. The muriate of ſilver, left behind, gave when reduced *half a grain* of *ſilver*.

I now digeſted the remaining part of the foſſil with nitro-muriatic acid, till the whole was diſſolved, except the ſilex. Upon this I diluted the ſolution with water, filtered it, and dropped into it a ſolution of ſulphate of iron. The *gold*, precipitated by this means, waſhed and heated to redneſs, weighed 13½ grains.

In conſequence of the *chemical inveſtigations*, which I have here communicated to the Public, and which I have ſeveral times repeated with ſome variations in the proceſs, I hope to have ſufficiently developed the hitherto not well underſtood or problematic nature of the *auriferous ores from Tranſylvania*, as well as to have fully demonſtrated the exiſtence of the *new*, *diſtinct metal* which they contain. It is now left to the induſtry of Mineralogiſts and Chemiſts to aſcertain: whether the *Tellurium*, by which name I call that new metal, may alſo occur in other places, or whether it ought to be conſidered as a gift, with which nature has *excluſively* endowed the Tranſylvanian gold-mines.

LXXIV.

CHEMICAL ANALYSIS

OF THE

SULPHURATED OXYD OF MANGANESE.

(SCHWARZERZ.)

From Tranſylvania.

BESIDES that red ore of manganeſe, which in various forms and with different ſhades of colour conſtitutes a principal matrix of the Tranſylvanian auriferous and telluric ores, there alſo occurs, chiefly at *Szekeremb*, another ſpecies of ore known by the name of *Black ore (Scwarzerz)* or *Black Blende*; of which the following are the external characters.

Its colour is a medium between the *browniſh* and the iron-black.

Moſt commonly it is found *maſſive*; it is alſo frequently croſſed by the red manganeſian ore in veins and alternate layers.

It is reſplendent of a *ſemi-metallic* luſtre. Fracture *uneven*, of a fine grain, and in a certain direction indiſtinctly *foliated*.

By the blow of the hammer it burſts into indeterminate *angular fragments* of not very obtuſe edges. Not tranſparent.

On the *ſtreak* it exhibits a *deep braſs-yellow* colour, very much paſſing to the green, and is *almoſt completely dull.*

It is *ſoft*, approaching to the degree of ſemi-hardneſs, and conſiderably *mild* *. Its ſpecific gravity I found to be 3. 950.

Mr. *Müller de Reichenſtein* was the firſt who mentioned this foſſil under the name of *Black Blende* ; but from his experiments he ſuppoſed it to be *Manganeſe* contaminated with a metallic ſulphuret †. At the ſame time *Bindheim* examined this ſubſtance, and aſſerted its conſtituent parts to be *Mangameſe*, *Sulphur*, *Iron*, and *Siliceous earth* ‡.

But ſince this mineral, which conſtituted a peculiar ſpecies of the genus *manganeſe*, does not appear to be generally known; I imagine to render ſome ſervice by publiſhing the reſults of my experiments concerning it.

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* By the term *mild*, the German Mineralogiſts underſtand that degree of coheſion of the particles of a foſſil, which does not render them entirely unmoveable; ſo that this expreſſion indicates a medium between *brittleneſs* and *ductility*, as is inſtanced in the galena, vitreous copper-ore, molybdena, &c. See *Emerling's Syſtem der aeuſſeren Kennzeichen der Foſſilien*, which the tranſlator of this work intends to render Engliſh.—Tranſl.

† *Phyſicaliſche Arbeiten des einträchtigen Freunde in Wienn*, 1 Jahrg. 1784: Pag. 86.

‡ Schriften der Berliner Geſelleſchaft naturforſchender Freunde. Vol. V. 1784. Pag. 452.

One

A.

One *hundred* grains of the above ore were ſtrongly ignited in a ſmall glaſs-retort, connected with the pneumatic mercurial apparatus. The neck of the retort was found lined with nothing elſe but a hardly perceivable aqueous dew. The gas that had paſſed over was pure *carbonic acid gas*, without any trace of ſulphurated hydrogen, and amounted to 7 cubic inches, or about 5 grains in weight. The remainder of the ignited ore has undergone no change that could be obſerved.

B.

a) Another *hundred grains* of the ſame foſſil were covered by degrees with a moderately ſtrong *nitric acid*. As often as any part of this ſolvent was poured upon it, a violent action took place, accompanied by effervefcence, and the extrication of ſulphurated hydrogen gas. The mixture was at firſt turbid and brown; but on affuſing the laſt portion of the acid it became yellowiſh-milky, much heated, and emitted white vapours, which lined the neck of the mattraſs with a yellow ſulphureous coating: and the ſulphur, which, at the beginning, ſeparated in detached delicate flocks, coaleſced into a yellowiſh grey, tenacious, porous maſs.

b) This maſs, when ſeparated by filtration, waſhed and deſiccated, weighed 16 grains. On being moderately heated upon a teſt, it ſuffered a loſs of 5 grains, which were ſulphur burned off. The reſidue, treated afreſh with nitric acid, now diſſolved; leaving $\frac{1}{2}$ grain more of ſulphur.

c) The filtered ſolution poſſeſſed a pale reddiſh colour, but was entirely deprived of it by dilution with water. To one half of it I added a lixivium of *cauſtic* ſoda. The oxyd of manganeſe, precipitated by it, very ſoon acquired a brown tinge by expoſure to air. The other half of the ſolution I precipitated by means of carbonated ſoda, and the manganeſian oxyd thus obtained preſerved its whitiſh colour unaltered in the air; becauſe the carbonic acid already combined with it, prevented it from attracting more oxygen from the atmoſphere.

C.

a) Upon one *hundred grains* of the pulverized manganeſian ſulphuret I poured nitric acid, weakened with twice its weight of water, and equipoiſed the veſſel together with its contents. Here the ſulphurated hydrogen gas was diſengaged without heat; and that portion of it which eſcaped, occaſioned a loſs of 34 grains of weight. What had remained of the ſeparated ſulphur, floated upon the ſolution in the form of brown, light flocks. The reſidue collected on the filter, weighed 3½ grains after drying. When moderately heated, only ½ of a grain of ſulphur burned away. The reſidue now entirely diſſolved in nitric acid, except ¼ grain of ſulphur, and a few grains of quarz hardly worth notice.

b) When I precipitated the filtered pale roſe-red ſolution by carbonate of ſoda, no effervefcence enſued. The precipitated oxyd appeared of a bright ſlate-grey; but, even while yet moiſt, it loſt this colour again, and turned white by being expoſed to the air on the filter. This colour, it is probable, aroſe from a ſlight portion of the ſulphurated gas, which ſtill adhered to the precipitate, and was afterwards expelled by the proceſs of waſhing. Of this carbonated

bonated oxyd of manganeſe, dried in the atmoſphere, the weight was 145 grains; but after it had been ſtrongly ignited in a ſmall retort, to which a receiver was joined, it weighed 82 grains. The ignited oxyd retained its white colour, while the veſſel was kept cloſed, except that its ſurface had a brown tinge.

c) To this ignited oxyd were added, before it cooled, 41 grains of ſulphur, and the retort being connected with a receiver brought to ignition in a ſand-heat. After refrigeration the exceſs of ſulphur was found ſublimed. The reſidue weighed 98 grains, and had a faint green colour, reſembling that with which the ſpecimens of the foſſil itſelf uſually become coated when long expoſed to the atmoſphere. This *artificial* ſulphurated oxyd of manganeſe diſſolved in dilute nitric acid, like the crude natural ſulphuret of this metal, with effervescence and development of ſulphurated hydrogen gas. In this experiment hardly any portion of concrete ſulphur remained.

D.

Another clear ſolution of this black manganeſian ore in *nitric acid* was evaporated in a retort to perfect dryneſs; it foamed very much towards the end of the proceſs, and emitted deep red nitrous vapours. The reſidue looked like an iron-grey, ſolid maſs, in part poſſeſſed of a metallic luſtre. It was manganeſe completely ſaturated with oxygen, at the expence of the nitric acid employed.

E.

The *muriatic* and dilute *ſulphuric* acids diſſolve this mineral as eaſily as the nitric. Theſe ſolutions are attended with effervescence and extrication of ſulphurated hydrogen gas; they

e of a pale-red, and yield after filtration by the ad-
of carbonated alkalies a pure, white, carbonated
f manganeſe, which turns black by ignition in an
ot. When in this ſtate, it is abſolutely inſoluble in
cid: but a perfect and colourleſs ſolution is obtained
ſoon as a little ſugar is added. Pruſſian alkali af-
vith this ſolution a pale precipitate reſembling in
the bloſſoms of flax, or only a whitiſh ore, accord-
the various degrees of oxydation.

F.

ough during the ſolution of this ore in acids a con-
e quantity of *ſulphurated hydrogen gas* is always given
et I conſider it as an error to ſuppoſe, that in this
l, (which is alſo to be underſtood of any other ſpe-
ore where this gas is obtained on their ſolutions in
mid way), the ſulphurated hydrogen had pre-
in it, and to enumerate it among its conſtituent
There cannot be any doubt, but that this compound
rated only during the proceſs, and at the expence
rtion of water which is then decompoſed. It is alſo
reaſon, that no trace of it was diſcovered in the
ic acid gas, expelled from this mineral by the aſſiſt-
f heat A). This aſſertion is ſtill more corroborated
theſis. For, in the artificial re-compoſition of this
l, by combining its recently ignited oxyd with ſul-
C. c.), no portion of hydrogen was made an ingre-
and notwithſtanding this, that combination yielded
addition of acids, in the ſame manner as the native
the ſulphurated hydrogen gas ſo abundantly, that
n the accompliſhed ſolution hardly any perceivable
of ſulphur, in ſubſtance, remained.

Therefore, ſince beſides the *oxyd of manganeſe*, the *carbonic acid* and *ſulphur*, no other eſſential conſtituent part was diſcovered in this analyſed foſſil, its proportion of ſulphur is eaſily determined from that of the two firſt mentioned component parts: allowing, however, 2 *per cent.* for the uſual loſs in ſuch proceſſes. Accordingly, the *maſſive, pure, ſulphurated oxyd of manganeſe* from *Szekeremb,* conſiſts of:

Oxyd of *Manganeſe* ſoluble in nitric acid . .	C. b) . .	82 parts.
Carbonic acid	A.) . .	5
Sulphur	F.) . .	11
		98

Concerning the traces of *quarz* and *iron* in the pure, ſelected ſpecimens of this foſſil, I found them too ſlight to deſerve being put in the account.

As little notice alſo have I taken of its contents in *gold* and *ſilver*. According to Mr. *Müller*, *one hundred pound* of the foſſil may be ſaid to contain *one ounce* of ſilver alloyed with gold, of which alloy one *mark*, or eight ounces, yield 24 deniers of fine gold, (about 472 grains Engliſh troy, and conſequently 59 grains in 100lb. of the foſſil). But as I diſcovered a ſlight indication of ſilver alloyed with gold, in only one ſingle ſpecimen, and none in the others; ſuch admixture of theſe noble metals is to be conſidered in this mineral as merely caſual.

LXXV.

LXXV.

CHEMICAL EXAMINATION

OF

TUNGSTATE OF LIME.

(*Scheelium* by Werner.)

I.

gſtate of Lime from Schlackenwalde in Bohemia.

IONG the numerous merits, which immortalize the e of *Scheele*, is an eminent one, the diſcovery of a liar metallic ſubſtance in the *tungſtate of lime*, or ore ngſten; a foſſil which, till his time, had been claſſed r with the ores of iron or with the tin-ores. From experiments, in which he has employed the pearl- ured variety from the iron-mine of *Bitſberg*, in Sweden, following appear to have been the conſtituent parts vered.

Oxyd of Tungſten	65
Lime	31
Silex	4
	100*

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the *mineralogical elementary treatiſes of Emmerling* and *others*, mponent parts of this foſſil, diſcovered by *Scheele*, are ſaid : 43. 75 tungſtenic acid, and 56. 25 calcareous earth. This

Therefore, ſince beſides the *oxyd of manganeſe*,
acid and *ſulphur*, no other eſſential conſtitue
diſcovered in this analyſed foſſil, its propo
phur is eaſily determined from that of the
tioned component parts: allowing, howev
for the uſual loſs in ſuch proceſſes. Accord
ſive, pure, ſulphurated oxyd of manganeſe
conſiſts of:

Oxyd of *Manganeſe* ſoluble in nitric acid . .	C. b)
Carbonic acid	A.)
Sulphur	F.)

Concerning the traces of *quarz* a
ſelected ſpecimens of this foſſil, I f
deſerve being put in the account.

As little notice alſo have I taken
and *ſilver*. According to Mr. *Müll*
the foſſil may be ſaid to contain
with gold, of which alloy one *ma*
24 deniers of fine gold, (about
and conſequently 59 grains in
as I diſcovered a ſlight indicat
gold, in only one ſingle ſpecimen
ſuch admixture of theſe noble m
this mineral as merely caſual.

s ſpecific

, previouſly
in a heat of
from the yel-
oration, I poured
a moderately warm
tion of the tungſtic
nitric acid ; and thus
pear. The reſidue was
manner, by boiling with
h ammoniac. In this way
foſſil was effected ; ſo that
emained.

then neutralized with cauſtic
hange enſued, it was precipitated,
arbonated ſoda ; and the precipitate
in a warm place. It weighed 33
of carbonated calcareous earth ; which,
olution in weak nitric acid depoſited
arth. For the mentioned 33 grains of
to be reckoned 17.60 grains of *lime*,
earth.

ſs ammoniacal ſolution ſhooted, by eva-
heat, into ſlender needle-ſhaped cryſtals,
h long. When thoroughly deſiccated to
left by this proceſs was triturated and

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tal of thoſe I poſſeſs of it, is an acute-angular,
l ; the baſis of which is of 1 inch in diameter,
ts 1½ inch, and its weight amounting to 734

ignited in a *platina* crucible, by means of a moderat encreaſed fire. The *tungſtic oxyd* which then remain behind, had the form of a heavy, greeniſh-yellow powde and weighed 77¾ grains.

Conſequently the *hundred grains* here examined of th *calcareous tungſtate* from *Schlackenwalde* have been decom poſed into:

Yellow oxyd of Tungſten	77.75
Lime	17.60
Silex	3.
	98.35

II.

Tungſtate of lime from Cornwall.

The *Corniſh tungſtate of lime* is met with at *Pengilly*, *Breage*, where, together with a yellow ochre, it ſerves a matrix to a fibrous brown-ironſtone, which it perv in ſmall veins. Its colour in the purer parts is white g intermixed with brown, or, as it were, marbled:— this genuine colour of the foſſil is defiled, and rendere diſcernible on many places, by a blackiſh mangan coating. It breaks maſſive without any determinate fi poſſeſſes a moderate waxy luſtre, exhibits an un granular, and in ſome parts ſplintery fracture. It is c and eaſily ground to an iſabella-yellow powder.—Sp gravity, 5.570.

One of its varieties conſiſts in a looſe aggregate of cryſtalline grains of a light-brown colour, in ſlaty l be

tween the interſtices of which an earthy carbonate of
nganeſe *(Braunſtein-guhr)* intervenes, which to thoſe
aces imparts a dirty, black brown colour. This variety
as denoted by the appellation; *Coffee-brown goſſan*; from
hich it appears, that this mineral has been conſidered, at
native place, as a ſpecies of ochraceous iron-ore.

It was *Raſpe* who firſt diſcovered, that theſe two ſpe-
es of that foſſil, before unknown, are of the nature of
lcareous tungſtate, or *Scheelium*; as may be learned from
s letter publiſhed in *Crell's Chemiſchen Annalen*, 1785.
ol. I. pag. 546.

A.

a) For a chemical analyſis I ſelected ſome pure pieces of
e firſt ſpecies, which occurs *maſſive*. Having finely pulve-
zed one *hundred grains* of it, I mixed them with 300 grains
f carbonated pot-aſh, and melted the whole in a crucible
nade of *platina*. The maſs was of a bright apple-green
fter cooling. When diffuſed through water, an iſabella-
ellow earth ſeparated, which I collected on the filter. Of
his the greater part diſſolved with effervеſcence in *nitric*
cid; what remained was digeſted in *muriatic* acid, which
iſſolved it, leaving behind only 1½ grain of merely *ſiliceous*
arth. To the muriated ſolution was added carbonate of
ot-aſh, but not longer than till it became cloudy; it was
hen made to boil, upon which a brown *oxyd of iron* ſepa-
ated in a flocculent ſtate, weighing 1½ grain after igni-
ion. The remainder of the colourleſs liquor was fully
aturated with carbonate of pot-aſh; which ſtill precipitated
grain of a white *oxyd of manganeſe*, rendered brown by
xpoſure to air.

b) The nitric ſolution alſo *a)* was precipitated by carbonated pot-aſh. The white precipitate, then obtained, conſiſted of calcareous earth in the carbonated ſtate, and weighed 34 grains; equivalent to 18. 70 of pure *lime*.

c) The colour of the alkaline liquor *a*) was faint greeniſh; it entirely diſappeared by warming, and depoſited ¼ grain of a brown oxyd of mangameſe. When afterwards neutralized with muriatic acid, the mixture aſſumed a milky appearance, and afforded a copious white precipitate.

However, ſince from this precipitate the real quantity of tungſten contained in the foſſil cannot accurately be determined; partly becauſe the precipitation is not complete, and partly becauſe the oxyd is not thrown down in its pure ſtate, but in a triple combination manifeſting the properties of an acid; I purſued the inveſtigation here explained by the following experiment.

B.

An *hundred grains* of the foſſil were decompoſed in the ſame method, by which I examined the preceding tungſtate from *Schlackenwalde:* that is to ſay, by treating them alternatively with muriatic acid and liquid cauſtic ammoniac. The ammoniacal ſolution was ſaturated with muriatic acid, the mixture evaporated, the dried maſs pulverized, and ignited in a *platina-crucible*, until the muriate of ammoniac was entirely expelled. The remaining *oxyd of tungſten* appeared now in the form of a looſe, bright-yellow powder, which readily diſſolved in melting phoſphoric acid, and gave to this laſt a beautiful, pure blue colour. It weighed 75¼ grains.

It reſults from this analyſis, that the conſtituent parts educed from one *hundred grains* of the *Corniſh tungſtate of Lime, were:*

Yellow oxyd of Tungſten	B . .		75.25 grains.
Lime	A. *b*)		18.70
Silex	—*a*)		1.50
Oxyd of Iron	— . .		1.25
Oxyd of Manganeſe . . .	—- *c*)	0.50 0.25	0.75
			97.45

LXXVI.

CHEMICAL EXAMINATION

OF

GADOLINITE *.

FIRST SECTION.

§ 1. *GADOLINITE* belongs to thoſe foſſils, with the diſcovery and knowledge of which the *mineralogical* branch of natural ſcience has of late been ſo conſiderably enriched. It is found as a black ſpecies of ſtone in the quarry at *Ytterby*, in *Roſlagen*, in *Sweden:* from this place it has alſo been called, *Ytterbite.* The firſt intelligence of it has been given by Mr. *Geyer*, of *Stockholm*, in *Crell's Chemical Annals*, 1788: according to which the merit of the diſcovery of this foſſil belongs to Mr. *Arrhenius.*—*Geyer* gave of it the following ſhort deſcription.

" It is a black ſtone, reſembling aſphaltum, or pit-coal; " of a conſiderable ſpecific gravity: *viz.* 4.223. It is " found in cluſters (*neſterweiſe*) in a red feld-ſpar (rhombic " quarz) which is intermixed with a ſilvery white mica. " Before the blow-pipe it ſwells up like zeolite, but after- " wards continues infuſible. With nitric acid it produces a " gelatinous coagulum; but, if previouſly calcined, it is " inſoluble in acids. By pulverization and calcination it

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* Read in the Royal Academy of Sciences at Berlin, on the 11th September, 1800.

"not only loſes its black colour, but alſo ſome pounds of "weight in the hundred. When fuſed with fluate of lime, "it yields a metallic globule of 8 *p.*, cent. attractible by the "magnet."

§ 2. Thus according to Mr. *Geyer.*—But even in that very year, I received from himſelf ſome ſpecimens of this ſtoney ſubſtance, under the doubtful denomination of black zeolite, in which I found the juſt now related deſcription and properties verified. A more accurate examination, however, was not poſſible on account of its ſmall quantity; and for this reaſon I was under the neceſſity of reſting ſatisfied with the reſult of ſome ſmall experiments, ſhewing that this foſſil cannot be annumerated to any of thoſe before known.

§ 3. Some years after this, Profeſſor *Gadolin* ſubjected it to a more complete chemical examination, of which a full account may be ſeen in the *Tranſactions of the Swediſh Academy* for the year 1794. In his paper the diſcovered component parts in the *hundred* are ſtated in the proportion of 31 *ſilex*, 19 *alumine*, 12 *oxyded iron*, and 38 of an *unknown earth*. From the experiments made for the purpoſe of accurately determining the nature of this unknown earth, *Gadolin* deduced: that it agrees in many points with the aluminous, in others, on the contrary, with the calcareous earth; and alſo, that it differs from both, as well as from every other ſpecies of earth we were till then acquainted with. He conſequently further inferred, that it ſeemed to deſerve a place among the *ſimple earths*; ſince all the experiments made with it, do not permit to ſuppoſe it compounded from the other known earths. Mr. *Gadolin*, therefore, has the merit of having firſt diſcovered this new earth in the foſſil, which is the ſubject of this preſent inquiry; and in this

LXXVI.

CHEMICAL EXAMIN

OF

GADOLINIT

FIRST SEC

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After having compared the pro-
thoſe of the known earths, *Ekeberg*
in likewiſe conſidering it as a new,
arth, to which he gives the name of

erning the hiſtory of Gadolinite. I ſhall
experiments which I inſtituted myſelf, and
which I was enabled by a ſufficient quantity of
ſpecimens *of it*, that were entirely free from
ous mineral ſubſtance. By this inquiry, the
thoſe two Swediſh chemiſts were not only con-
ut alſo in part rendered more correct.

SECOND SECTION.

ſcription of Gadolinite as to its external characters.

olour of Gadolinite is a *deep greeniſh-black*; in the
d ſtate it is greyiſh-green.

urs *maſſive*, or in middle ſized lumps, and alſo *coarſely diſſeminated* in a granitic maſs mixed with a reddiſh feldſpar.

Its exteriour *ſurface*, though rifty, is *glittering*, and moſt frequently covered, as it were, with a whitiſh caſing.

On the *freſh fracture* it is *reſplendent*, of the ordinary luſtre.

Its *fracture* is *conchoidal*, and exhibits a compact, ſomewhat uneven texture, paſſing to the ſlaty.

It *burſts* under the hammer into indeterminate, angular fragments of ſharp edges.

It is opake: only its ſharp edges and thin ſplinters, when held againſt the light, are tranſparent of a greeniſh caſt.

It is ſo *hard* as not to admit of being ſcratched with the knife; though its hardneſs is not of ſuch a degree as to ſtrike fire with a ſteel.

Concerning its ſpecific gravity, I found it to be 4.237 which very nearly agrees with that obſerved by *Geyer*.

II. *Decompoſition of Gadolinite.*

A.

§ 1. Upon *two hundred grains* of finely ground Gadolinite, two ounces of *muriatic* acid were poured. The temperature of the mixture became of itſelf moderately raiſed; the greater part of the foſſil was taken up by the ſolvent, and the ſiliceous earth ſeparated in a gelatinous form and much ſwelled. After a total decompoſition had been effected by means of digeſtion, I collected the *ſiliceous* earth and heated it to redneſs. It weighed 49 grains.

§ 2. The liquor freed from this earth was evaporated to dryneſs, and covered with ſpirit of wine; in which it diſſolved entirely and without any turbidneſs. This ſolution I diluted with water; and on the addition of *cauſtic* ammoniac a copious precipitate of a pale-brown colour fell down. No more precipitate could be obtained from the remaining fluid, by combining it with carbonated pot-aſh: neither in the cold, nor on boiling it.

§ 3. The brown precipitate was diſſolved in *ſulphuric* acid, evaporated to dryneſs, and ſtrongly ignited during half an hour. It then acquired the form of a brick-red pulverulent maſs. After this had been elixiviated, the fluid ſeparated from it by filtration was deſtitute of all colour, and was particularly remarkable by a certain ſtriking ſweet taſte, which ſeemed to me to be a medium between the taſte of ſulphate of glucine, and acetite of lead. I ſaturated it to exceſs with carbonated ammoniac; upon which the white earth that at firſt fell down, again totally diſappeared by degrees. The liquor which thus had again become clear, I introduced into a retort, and diſtilled from it the ſuper-abundant portion of ammoniac added before. The remaining liquor ſoon loſt its limpidity, and let fall a white looſe earth; which, edulcorated and dried in a gentle heat, weighed 149 grains. When afterwards ſtrongly ignited, its weight proved to be but 80 grains, and its colour had changed into a bright iſabella-yellow.

§ 4. That brick-red earth which after the elixiviation of the ignited ſulphated maſs with hot water, had remained upon the filter, weighed, after waſhing and deſiccation, 76 grains.—*One half* of it was mixed by trituration with ſome drops of linſeed-oil, and heated to redneſs in a covered crucible. But, as ſubſequently to this operation, it did not exhibit, in all its parts, an equally black colour, and alſo was but imperfectly obeying the magnet; it was a ſecond time treated with ſulphuric acid, inſpiſſated together with this ſolvent to a dry maſs, and ſtrongly ignited, as before. This, when afreſh extracted with water and filtered, again yielded a clear, ſweet-taſted liquor, from which carbonate of pot-aſh precipitated a white, incoherent earth, of the ſame properties with that procured in the firſt treatment.

§ 5. The *other half* of the mentioned brick-red earth was put in digeſtion with muriatic acid. In this inſtance its complete ſolution was effected with difficulty, and only after repeated affuſions of the ſame menſtruum. The laſt of the reſpective reſidues had a light fleſh-colour. It was diſſolved ſeparately, and precipitated with a lixivium of cauſtic pot-aſh. A ſlight exceſs of this precipitant re-diſſolved a ſmall portion of the precipitated earth. This, when again recovered by ſuperſaturation with muriatic acid and precipitation with carbonated pot-aſh, was afreſh diſſolved in *ſulphuric* acid; it then gave, by means of a proper management, a few ſmall cryſtals of alum.

The muriatic ſolution obtained at firſt was examined in various ways; from which it reſulted, that this liquor, beſides a portion of iron, alſo had contained a portion of the white earth mentioned before.

From the reſult of this analytical proceſs I have, therefore, learnt that the way, which Mr. *Ekeberg* reſorted to in his attempt to ſeparate the *Yttria* from the *iron*, by mean of igniting the dry ſulphated maſs, does not lead to a complete decompoſition of Gadolinite, and to an accurate knowledge of the true proportion of theſe two of its conſtituent parts. For this reaſon I endeavoured to attain this end by

various

arious other expedients; among which I have found that ethod the moſt ſucceſsful, which I tried in the following nalyſis.

B.

§ 1. I ignited, in a covered crucible, *two hundred* grains of Gadolinite in ſelected very pure pieces. They returned from the fire cleft in a ſlaty manner and thereby rendered friable, of a dirty iſabella-yellow colour inclining to the light-brown, and with a loſs of one grain of weight.

§ 2. They were then finely pulverized, and digeſted with *nitro-muriatic acid* until the mixture was completely decompoſed.—As the ſiliceous earth entering into the compoſition of this foſſil, is very much diſpoſed to ſwell up conſiderably by imbibing the ſolvent during its ſeparation; for which reaſon the mixture coagulates into a thick jelly-like ſubſtance, and as in this condition it firmly ſticks to the bottom of the veſſel; this inconvenience may be eaſily remedied by keeping the matraſs in conſtant agitation above the charcoal fire, inſtead of lodging it in a ſand-bath. For, by ſo doing no time is left to the ſwelled maſs to ſettle firmly.

When this decompoſition was accompliſhed, I evaporated the mixture, in a ſand-heat, to a moderate dryneſs: agitating it frequently. Upon this I again ſoftened the maſs with hot water, acidulated a little with muriatic acid. The ſiliceous earth, which then remained, was ſeparated by filtration, waſhed, and ignited. In this ſtate it weighed 42½ grains.

§ 3. The filtered ſolution was, at the beginning, light brown-red; but this colour ſoon after ſpontaneouſly paſſed to left had been ſeparated by ſolution in hot water, there [illegible] [illegible] eight grains of undecompoſed yttria.

Therefore, ſince according to this experiment a ſmall portion of ſulphated yttria is already and immediately decompoſed, at that intenſity of ignition which is neceſſary to decompoſe the ſulphate of iron: it becomes obvious that the method, reſorted to by Ekeberg, in order to ſeparate the iron from the yttria by igniting the ſulphated maſs, [illegible] lead to the diſcovery of the true proportion of their two ingredients in gadolinite: as is alſo proved by the following experiment.

I decompoſed *one hundred grains* of gadolinite by boiling with diluted ſulphuric acid, inſpiſſated the mixture, and having rediſſolved it in ebullient water, I filtered off the ſiliceous earth. It is worth remarking, that the whole ſolution, notwithſtanding the conſiderable portion of iron it contained, was entirely colourleſs. I then evaporated it to dryneſs, and ignited it during half an hour in a heat rather ſtrong: upon which I diſſolved the maſs, which had returned from the fire with a brick-red colour, in hot water and threw it upon the filter. Laſtly, I precipitated the filtered liquor with carbonated ſoda; but it yielded no more than 11½ grains of dry carbonate of yttria: though in conſequence of the preceding analyſis, it ſhould have given 59¼ grains.—Whence by the ignition during half an hour not only the ſulphate of iron, but alſo by far the greateſt part of the ſulphated yttria had been decompoſed, and the ſulphuric acid driven out. For this reaſon I found myſelf obliged to ſeparate that portion of yttria which was ſtill contained in the reſidue left on the filter, by a ſubſequent operation.

4. The ſolutions of yttria in *nitric* and *muriatic* acid are incapable of cryſtallization. When concentrated by

18 grains of the expelled carbonic acid gas from thoſe 45, *one hundred parts of carbonate of yttria* contained :

Yttria	55
Water	27
Carbonic acid	18
	100

§ 2. The ſulphuric ſolution obtained § 1. was made to cryſtallize by ſlow evaporation. It ſhooted through the whole proceſs into ſmall cryſtals, the primitive form of which ſeemed to be a rhomb, of a colour inclining to a pale amethyſt-red, and of a ſweet taſte, which, however, at laſt becomes a little aſtringent. The ſpecific gravity of theſe cryſtals was 2.790. They diſſolve but difficultly in cold water, and require of it from 25 to 30 parts. Even in hot water they are not diſſolved with much greater readineſs.

But although this ſulphate of yttria, as to its ſweet taſte, is but little diſtinguiſhable from that neutral ſalt, which glucine produces by combination with ſulphuric acid : yet theſe two ſalts entirely differ in their other properties.— Sulphated glucine is abſolutely colourleſs, exhibits a different form of its cryſtals, is leſs heavy, unites to a larger quantity of water of cryſtallization, and is, for this reaſon, of a more eaſy ſolution in water.

§ 3. A *red heat decompoſes* the ſulphate of yttria ; it cauſes the ſulphuric acid to volatilize, and only the earth remains behind. *Sixty* grains of cryſtallized ſulphated yttria were ignited for fifteen minutes in a porcelain veſſel. The reſidue returned from the fire of a pure white colour ; yet ſtill taſting ſweet, which ſhewed, that at this degree of heat one part of the ſalt had eluded the decompoſition. When this

laſt had been ſeparated by ſolution in hot
mained *eight* grains of uncombined yttria.

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portion of ſulphated yttria is already and u
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4. The ſolutions of portion, a re-diſſol-
are incapable of cryſtalli the carbonated amm

d attended with ſimilar phenomena.—By neutralization
th acids the precipitate is again reſtored.

§ 9. But if for this precipitation pot-aſh or ſoda be em-
yed in their pure or *cauſtic* ſtate, no re-diſſolution is per-
ved on adding them in exceſs. Only by boiling the re-
ntly precipitated earth in a cauſtic lixivium it, ſeems that
mall portion of it is again taken up by the alkali.

§ 10. To a *perfectly neutralized*, and with water but mo-
ately diluted, *muriatic ſolution* of yttria was added *Pruſſian*
ali. A precipitate enſued, white at firſt, but after ſome
ne paſſing into the pearl-grey: conſiſting of pruſſiate of
ria, which in a pretty ſhort time ſubſided as a heavy
wder. The ſupernatant liquor contained little or no
th at all. On the addition of a ſmall exceſs of acid, the
cipitate diſappeared. This property of yttria, to be
cipitated by neutral pruſſiates, is an obſtacle to their ap-
cation, for the purpoſe of ſeparating the iron, in the
ceſs of decompoſing gadolinite. This contemporaneous
cipitation, however, of the pruſſiated yttria and pruſſiated
n, may in ſome degree be prevented by previouſly adding
re acid to the ſolution of gadolinite freed from its ſilice-
ingredient, or by re-diſſolving the pruſſiated earth,
en already precipitated, by a portion of acid added afreſh.
this affinity with Pruſſic acid yttria widely differs from
cine; as with this laſt and the pruſſiated ſalts no preci-
tion takes place.

11. In the ſame manner yttria enters into combination
h *tannin (materia ſcytodephica.)* I mixed a perfectly
tral muriate of yttria with an aqueous ſolution of that
nciple, prepared from gall-nuts, and obtained a copious
cipitate in the form of bright-aſh-grey incoherent flocks.
nen I employed the common tincture of galls, a ſimilar
cipitation was effected: the pure gallic acid, on the
contrary,

contrary, produced only a ſlight turbidneſs.—This property, of being precipitated by tannin, likewiſe furniſhes another character diſtinguiſhing yttria from glucine.

§ 12. Pure yttria ſhewed to me no attraction for *ſulphur*.—Into a ſolution of it mixed with ſulphuret of ammoniac I dropped an acid; it let fall down the ſulphur of a milk white, which, collected and heated, burned off, and left no reſidue.

By the *ſulphurated hydrogen gas* likewiſe, not the leaſt change was produced in diſſolved yttria. For this reaſon I attempted to employ this gas as an expedient of ſeparating the iron from the yttria.—To attain this end I paſſed ſulphurated hydrogen gas through a ſolution of gadolinite, previouſly freed from its ſiliceous portion: yet no change whatever, or turbidneſs enſued. But when the ſulphurated hydrogen was previouſly combined with pot-aſh or with ammoniac, the ingredient iron fell down, as a ſulphuret of iron, in copious black flocks. Hence it appears that, beſides the neutral ſuccinates, the alkalis fully ſaturated with ſulphurated hydrogen may, for the future, be uſefully employed for the purpoſe of ſeparating iron and yttria from each other.

§ 13. *Oxalic acid* and *oxalate of pot-aſh* form with diſſolved yttria a white, pulverulent precipitate.

§ 14. *Tartrite of pot-aſh* affords a like precipitate, which is re-diſſoluble on the affuſion of more water.

§ 15. *Phoſphate of ſoda* gives a white precipitate.

§ 16. *Arſeniated pot-aſh* yields the ſame product.

§ 17.

§ 17. Muriate of yttria, diluted with a ſufficient quantity of water, continues limpid and unaltered on the addition of *ſuccinate of ſoda*; but on ſubſequent ſlow evaporation of the water ſmall, ſolid, and ſeemingly cubical cryſtals ſhoot. Therefore, on reſorting to this means of ſeparating the iron from gadolinite, it is neceſſary to dilute its ſolution ſufficiently; leſt, beſides the ſuccinate of iron, at the ſame time alſo a precipitate of ſuccinated yttria be formed.

Acetite of yttria, when combined with ſuccinated ſoda, afforded no ſuch cryſtals; the mixture only deſiccated to a tenacious maſs. The affinity of ſoda, therefore, appears to be greater to the ſuccinic, than to the acetic acid; while, on the contrary, in a preceding operation (II. Sect. B. § 3.) its attraction for the ſuccinic acid was found inferiour to that for the muriatic.

§ 18. In the graduated arrangement of the chemical affinities of acids with other ſubſtances, yttria is inferiour to barytes, ſtrontian and lime. Conſequently the firſt is thrown down from its ſolutions in the nitric and muriatic acids, whenever ſuch a ſolution is mixed with that of any of the three laſt mentioned earths.

§ 19. Yttria when heated, before the blow-pipe upon charcoal, with a continued ignition, is diſſolved by concrete phoſphoric acid as well as by borax, and runs into a clear, colourleſs vitreous globule.

FOURTH SECTION.

By means of theſe analytical experiments, I now flatter myſelf with having confirmed the exiſtence of yttria in the character of a diſtinct earth, as alſo with having fully entitled it to being ranked among the chemical principles at preſent known; or in other words, among thoſe ſimple ſubſtances, which as yet have eluded all attempts to decompoſe them.—But although its proper place in the mineralogical ſyſtem is in the claſs of the ſimple earths; yet it is a remarkable circumſtance, that with regard to ſome of its properties it ſeems to indicate a tranſition from the ſimple earthy to the metallic ſubſtances: and that in the chain of earths it is the neareſt link, which connects theſe two claſses.—To theſe properties I reckon principally:

1.) The *precipitation* of yttria *by pruſſiate of* pot-aſh.—However, this tendency to enter into combination with the pruſſic acid, and to form with it a precipitate, after the predominant portion of the acid in any of its ſolutions has been removed, as it were, by neutralization, it ſeems, in ſome manner to poſſeſs in common with Jargonia (*Zircon.*)—But, when ſome aſſert that alſo barytes, and others that alumine is precipitated by neutral pruſſiates; I think, from the reſult of my own experiments, that in both caſes an error muſt intervene, occaſioned by ſome caſual circumſtances.

2.) The *amethyſt-reddiſh colour*, which is peculiar to the ſulphated and acetated yttria.—This is the firſt known inſtance of an earthy neutral ſalt poſſeſſed of a determinate colour. On the other hand, I have convinced myſelf by means of appropriate experiments, that this colour ariſes not from ſome iron, perhaps retained, or even from a hidden portion of manganeſe ſuppoſed to enter into the gadolinite.

By way of concluſion, I add only this remark: that it is not always adviſeable, to take the denomination of a new-diſcovered ſubſtance or natural body from any one of its properties ſingly. At the time, that *Vauquelin* gave to the new earth which he diſcovered in the beryl and emerald, the name of *glucine* or *ſweet earth*, from its property of forming ſweet neutral ſalts; he certainly did not expect that ſhortly after another earth would be found, entitled with an equal right to claim the ſame name. Whence, in order to prevent the confounding the glucine with yttria, it might perhaps be prudent to ſuppreſs the denomination, *glucine*: and to uſe in its ſtead that of *Beryllina*; which laſt has already been recommended by Profeſſor *Link*, more eſpecially upon the ground that there already exiſts a genus of plants called *glucine*.

LXXVII.

CHEMICAL EXAMINATION OF THE EGYPTIAN NATRUM.

(*Soda from* EGYPT.)

THE *natrum*, *ſoda*, or *mineral alkali* from Egypt, which from the remoteſt ages has been a well known article of commerce, is annually produced by nature in very great quantities, in the *Natron lakes*, as they are called, in the deſert of Makarius in *Lower Egypt*. For our preſent more complete knowledge of thoſe remarkable lakes we are indebted to *Berthollet* and other French philoſophers, who accompanied the French Expedition to Egypt, and have accurately examined and deſcribed them.

Yet thoſe lakes do not always and every where afford the ſoda of preciſely the ſame nature and good quality: but more or leſs contaminated with a muriate and ſulphate of ſoda.

That particular variety of natrum or ſoda from the lakes of Egypt which furniſhed the ſubject of this preſent inquiry, forms a granularly cryſtallized, grey-white, and, in ſome parts, light-brown coloured maſs, of a tolerably firm coheſion, and defiled by a grey ferruginous marl; which a preliminary examination has ſhewn to amount to 4 *per cent.*

a) *Five hundred and twenty grains* of this natrum, in which, therefore, the pure ſaline contents amounted to 500 grains, were diſſolved in water, and, after the earthy parts had been removed by filtration, accurately ſaturated with *nitric* acid, the quantity of which was determined by weight.—An equal weight of the ſame acid was now neutralized with *dry carbonate of ſoda*, of which 163 grains were requiſite to ſaturate the acid.

b) The neutralized ſolution was next combined with diſſolved *nitrate of barytes*; which produced a copious precipitate of a bayritic ſulphate.—The quantity of this laſt weighed 174 grains, and indicates that 104 grains of *dry ſulphate of ſoda* had been contained in the liquor.

c) The remainder of that ſolution was precipitated by means of *liquid nitrate of ſilver*. The muriate of ſilver, thence ariſing, edulcorated and dried, amounted to 176 grains; which prove the previous exiſtence of 75 grains of *muriated ſoda* in the fluid under examination.

Hence this particular ſort of the *Egyptian natrum*, here examined, if we exclude its earthy admixture, contains

Dry carbonate of ſoda	163
Dry ſulphate of ſoda	104
Dry muriate of ſoda	75
Water of cryſtallization	158
	500

LXXVIII.

CHEMICAL EXAMINATION

OF THE

STRIATED SODA.

(*Striated Natrum* *.)

It is a well known fact, that recently cryſtallized carbonate of ſoda, when expoſed to the open air in warm weather, gradually loſes its water of cryſtallization which conſtitutes the greater half of its weight, and thus crumbles into a farinaceous powder. From this cauſe alſo is the native ſoda at *Debrezin* in Hungary, on the *Monte Nuovo* near Naples, and other places, commonly found withered to an incoherent duſt.—Notwithſtanding this, the natrum or ſoda from the lakes in Egypt frequently occurs in cryſtalline maſſes of a very conſiderable hardneſs, ſo that even the walls of *Qaſrr (Caſſr)*, (a fort now in ruins near the natrum lakes,) have been built of ſuch ſtone-hard ſoda; of which, however, the muriate of ſoda commonly mixed with it, is the cauſe.

The *ſtriated ſoda*, though generated by nature in a hot climate in the interior parts of Africa, is not ſubject to ſuch withering or efloreſcence. It was the object of this inquiry to diſcover the cauſe of this variation in the properties of, in other reſpects, one and the ſame alkaline ſubſtance.

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* Journal de Phyſique, Meſſidor, An. VIII. Page 6.

Mr. *Bagge*, Swediſh Conſul at Tripolis, has given of this remarkable ſpecies of ſoda the following account and deſcription*. "*The native country of this ſoda, there called* "Trona, *is the province* Sukena, *two journeys diſtant from* "Fezzan. *It is found at the foot of a rock-mountain upon* "*the ſurface of the earth, at no greater depth than that of* "*an inch, and as to breadth moſtly that of the back of a* "*knife's blade. It occurs always cryſtallized*; *on the frac-*"*ture it exhibits concrete, oblong, parallel, and ſometimes* "ſtriated cryſtals: *thus reſembling crude or unburnt gypſum.* "*Over and above the large quantity of* Trona *which is ex-*"*ported to the* country of the Negroes *and to* Egypt, *there* "*are brought of it to* Tripoli 1000 *centners* (of 100lb.) "*every year. It is not contaminated with* common ſalt; "*the ſalt-mines exiſt near the ſea-coaſts, but the* Trona *is* "*found in the interiour part of the country at a diſtance of* "28 *journeys from the ſea.*"

The ſoda examined by the experiments I am going to relate, forms a cryſtallic incruſtation of the thickneſs of from one third to half an inch, of accumulated parallel plates, ſtanding on their ſmall edges, and of a lamellar ſtriated texture.

A.

Two hundred grains of it in pure ſpecimens, which have been freed from the ſandy particles adhering to their lower ſurface, were diſſolved in water, and upon the equipoi ſcale of the balance neutralized with *nitric acid*. T weight of the expelled carbonic acid gas was 76 grains.

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* Schriften der Schwediſchen Academie der Wiſſenſchaften. Band 35. Alſo in Crell's Neueſte Entdeckungen in der Chemie. 1 Theil. p. 95.

On pouring a ſolution of *nitratrated barytes* into th neutralized lixivium, it became turbid and depoſited grains of ſulphate of barytes. But, as the ſulphuric ac thus pointed out muſt be conſidered as being in a neutr combination: *five* grains of ſulphate of ſoda, in the dr ſtate, are to be reckoned for it.

After the ſolution had in this way been freed from its ſulphuric acid, it was tried with liquid *nitrate of ſilver*. But this gave to it only an opalizing appearance; and ſo faint, that the ſmall portion of muriatic acid, indicated by it, was not worth conſidering.

Nitrated ſoda, in its uſual rhomboidal cryſtals, was obtained from the ſolution treated by the mentioned reagent.

B.

Of the ſame ſtriated ſoda *two hundred grains*, in entire pieces, were expoſed to a moderate red-heat in a ſilver veſſel. The cryſtals returned from the fire of a dull white; but had undergone no change in their figure by this proceſs. Their weight was diminiſhed 62 grains.

Thoſe 138 grains, which remained after ignition, were then neutralized with dilute *ſulphuric acid*, which cauſed another loſs of 59 grains of weight.

The whole loſs of weight, therefore, conſiſted in 121

grains.

s. But, ſince the proportion of carbonic acid con-
d in 200 grains of ſoda, here examined, before it was
ed, amounts to 76 grains (A); it follows, that during
ignition, beſides its aqueous portion, alſo 17 grains of
onic acid had eſcaped at the ſame time.—Theſe 17
ns, ſubtracted from the 62 loſt by ignition, reduce
rue proportion of the *water of cryſtallization* to 45 in
grains.

onſequently, one *hundred parts* of the *ſtriated ſoda* from
oli contain:

Water of cryſtallization	22. 50
Carbonic acid	38.
Pure ſoda	37.
Sulphate of ſoda	2. 50
	100 parts.

we now compare with this the proportion of the com-
nt parts of which the *common carbonated ſoda*, in freſhly
ared cryſtals conſiſts, namely:

Soda	22
Carbonic acid	16
Water of cryſtallization	62
	100

e perceive a ſtriking difference in the reſpective pro-
ions of the carbonic acid. For, inſtead of the uſual
ortion of carbonic acid to 100 of common ſoda being
oſt 73, that in the Tripolitan ſoda amounts to nearly
; hence about 30 more than in the firſt.

It ſeems, then, that it is from this more complete ſaturation with carbonic acid, that this ſpecies of ſoda derives its capableneſs to reſiſt efferveſcence and withering.

Doubtleſsly, there coincide on the very ſpot, where this *ſtriated* ſoda is generated, ſuch circumſtances, as favour this higher degree of impregnation with carbonic acid; but of theſe we can expect a more particular information from ſuch naturaliſts only, as may find opportunity for making proper inquiries on the place itſelf.

The common carbonate of ſoda not containing the *maximum* of carbonic acid, is therefore ſtill capable of taking up conſiderably more of it; and this complete ſaturation may be accompliſhed by the ſame method, by which the fully ſaturated carbonate of pot-aſh is obtained. Soda fully impregnated by ſuch *artificial* proceſs, with carbonic acid, already in ſome manner reſembles the *native* one as to its external characters: partly by the lamellated texture of its cryſtals, and partly by being thereby rendered more proof againſt withering and decay.

LXXIX.

LXXIX.

CHEMICAL ANALYSIS

OF THE

NATIVE MURIATE OF AMMONIAC.

(Sal-Ammoniac.)

I.

Muriate of Ammoniac from Mount Veſuvius.

AFTER the eruption of Veſuvius, in the year 1794, rt of the matters evaporating from the hot lava, during e ſpace of ſeveral weeks, coaleſced by ſpontaneous iniſſation into concrete ſalts; which are found, in various rms, in the fiſſures and cavities *(fumaroli)* of the reigerated uppermoſt ſcoriæ of the lava. The products of is natural proceſs of ſublimation are chiefly *Muriate of mmoniac* and *Muriate of Soda.*

The muriate of ammoniac, there obtained, occurs partly a ſtate of purity, partly coloured yellow, and is moſt equently cryſtallized in diſtinct, quadrangular, ſomewhat clined columns, which are much ſplendent and pellucid.

Moſt of the muriated ſoda preſents an irregularly fuſed uſtaceous ſaline maſs, of a coarſe fibrous fracture. It is ldom entirely pure, but moſt frequently tinged more or ſs green by oxyded copper, and in many places, as it ere, beſtrewn with minute brilliant laminæ of the ſpecur iron-ore.

As to the muriate of ammoniac, it, undoubtedly, muſt be conſidered as a product only then generated; ſo that its baſis, the *ammoniac*, is compoſed of the *hydrogen* and *nitrogen* from the water and the atmoſpheric air, which during that great chemical operation of Nature, undergo decompoſition.

But concerning the muriate of ſoda, it is not neceſſary to ſuppoſe it to be a ſubſtance newly generated from its principles. For, its origin becomes of itſelf obvious, if we conſider the acceſs of the ſea-water to the ſubterraneous fire-places of the volcano as a neceſſary co-agent at their eruptions. A quantity of ſea-ſalt is then, without doubt, decompoſed; and a part of its acid, thus ſet free, uniting with the naſcent ammoniac forms muriate ammoniac.

A.

a) *Three hundred* grains of the white, cryſtallized Veſuvian muriate of ammoniac, introduced into a retort, were made to ſublime by means of a proper degree of heat. The ſublimate obtained was diſſolved in water, ſuperſaturated with a few drops of *muriatic* acid, and combined with a ſolution of *muriated barytes*. The mixture continuing clear and limpid, ſerved as a proof that the ſublimate was a pure, uncontaminated muriate of ammoniac.

b) The reſidue in the retort, which ſtill contained a ſmall portion of that ſalt, was diſſolved in water; and, having been filtered off from a kind of grey, ſandy earth, which proceeded from ſome fragments of the lava adhering to the muriated ammoniac employed, and weighed $3\frac{1}{4}$ grains; it was again evaporated to dryneſs, and expoſed to a red-heat. There remained $1\frac{1}{4}$ grain of muriated ſoda.

Hence the cryſtallized muriate of ammoniac, ſubjected to this examination, proved to contain no other ſubſtance but merely muriated ammoniac, with the exception of ½ *per cent.* of ſea-ſalt.

In another, leſs regularly cryſtallized variety of the ſame ſaline ſubſtance, I found the admixed muriate of ſoda to bear rather a greater proportion.

The abſence of ſulphuric acid, a portion of which it has been ſuſpected to contain, is ſo much the more remarkable; as the generating proceſs of this muriated ammoniac is carried on in an atmoſphere impregnated with ſulphureous exhalations.

B.

The *yellow variety* of the Veſuvian muriate of ammoniac agrees with the *white* one as to the figure of its cryſtals. Its colour, which is a fine *topaz yellow*, depends on admixed iron; but in ſo ſmall a quantity, that it can ſcarcely be eſtimated at ⅛ *per cent.*

II.

Bokarian Muriate of Ammoniac.

The *Bokarian Tartary* (a diſtrict of Uſbek Tartary, in Aſia) furniſhes a *native* muriate of ammoniac; which in its external characters differs from that generated in the lavas of mount Veſuvius; but we are not yet ſufficiently acquainted with its origin and natural hiſtory.

The firſt, and, perhaps, till now only account of it, has been given by *Model**. As, according to his aſſertion, ſeveral centners are annually tranſported of it to Siberia and Ruſſia, or at leaſt have been brought thither in his time; we are by this fact led to conclude, that this muriated ammoniac is met with in conſiderable quantities on its native place. The intelligence, that it is produced upon rocks, acquires probability from the ſtony fragments, which in part ſtill adhere to the lumps of that ſalt, and ſeem chiefly to conſiſt of argillaceous ſlate and indurated clay. Beſides, it deſerves notice, that ſome ſmall detached pieces of yellow ſulphur are found among the grains of this muriate.

When conſidered in an *oryctognoſtic view*, this ſalt deſerves to be claſſed as a *peculiar ſpecies* of muriated ammoniac. *Karſten* deſcribed it, under the denomination of *conchoidal Sal-ammoniac*, in the manner as follows:

> "It is greyiſh-white,
> in angular pieces of
> an *uneven ſurface*;
> Externally glittering,
> *internally reſplendent of the glaſſy luſtre*,
> Fracture *in ſome degree perfectly conchoidal*;
> fragments indeterminately angular.
> It paſſes from the ſemi-tranſparent to the opake;
> is flexible *(geſchmeidig)*,
> ſoft,
> light,
> of a predominant urinous taſte."

My experiments have confirmed the opinion of *Model*; viz. that the conſtituent parts of this native muriate of

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* J. G. *Model*'s Verſuche and Gedanken über cin natürliches, oder gewachſenes Salmiak. Leipzig, 1758.

ammoniac

mmoniac are the ſame with thoſe, of the like ſalt artifici- ly prepared; excepting only a ſlight portion of ammo- iacal ſulphate, which I found mixed with it.

Two hundred grains of it in ſelect pure granular pieces were expoſed to ſublimation. The whole of it volatilized, without leaving any notable reſidue. After the ſublimed ſalt had been diſſolved in water, acidulated with a few drops of muriatic acid, *muriate of barytes* was added. This produced a precipitate, conſiſting of 9 grains in weight of ſulphate of barytes.

In order to learn the proportion of the ſulphated ammoniac, the preſence of which was indicated by this precipitation, I diſſolved 100 parts of dry, cryſtallized ſulphate of ammoniac in water, and decompoſed the ſolution with muriated barytes. The quantity of barytic ſulphate, then procured, amounted to 180 parts.

Therefore, as according to the reſult of this experiment, the mentioned 9 grains of ſulphate of barytes indicate 5 grains of ſulphate of ammoniac, it follows that one *hundred* parts of the native *Muriate of ammoniac from the Bokarian Tartary* contain:

Muriate of Ammoniac	97.50
Sulphate of Ammoniac	2.50
	100

LXXX.

CHEMICAL EXAMINATION

OF

SASSOLIN.

THE *native Boracic acid*, deſignated by the appellation, *Saſſolin*, is a white ſalt, ſpotted in ſome parts of an iſabella-yellow colour; it is eaſily pulverizable, of a ſoft and ſoapy feel, and a ſtalactitical form.—Its principal conſtituent part is the *free*, or uncombined *boracic acid*.

For the firſt information of the exiſtence of a native boracic acid, the public is indebted to Mr. *Höfer*, of Florence, who diſcovered it in the waters, iſſuing from the mountain with an ebullient heat, on the lake *Cherchiajo*, near *Monte rotondo*, as well as in the lake of *Caſtelnuovo*.

But that *concrete* boracic acid, which goes by the name *Saſſolin*, has been found by Profeſſor *Maſcagni* on the borders of the hot ſpring near *Saſſo*, in the territory of Sienna; from which place *Karſten* * has taken the name of this ſpecies of ſalt.

A more detailed deſcription of the external properties of

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* *Karſten*, Mineralogiſche Tabellen. Berlin, 1800, pag. 40.

Saſſolin has been given by *Eſtner* * in his Elementary Treatiſe on Mineralogy, under the name, *native ſedative ſalt*; to which I refer the reader.

A.

a) *One hundred and fifty grains of Saſſolin* diſſolved in 4 ounces of boiling water, left 6 grains of a light and aſh-grey earth. The filtered ſolution, evaporated to cryſtallize, afforded by degrees 128 grains of boracic acid, in the uſual form of minute light and ſhining laminæ.

b) After theſe, other cryſtals ſhooted, for the greateſt part in rhombic plates with ſharp edges. On trying ſome of theſe for muriatic acid, by means of a ſolution of ſulphate of ſilver, no turbidneſs appeared. From others, examined with *acetated barytes*, a precipitate of ſulphate of barytes was inſtantaneouſly obtained.

When put upon the charcoal and heated, theſe cryſtals intumeſced, and fell into a dry powder; at firſt whitiſh, but afterwards inclining to the brown.

Another part of thoſe cryſtals, diſſolved in water and treated with a lye of cauſtic pot-aſh, yielded a pale brown precipitate, which turned black in the air. This precipitate gave to borax-glaſs, before the blow-pipe upon charcoal, a ſmutty amethyſt-colour. Vitrified phoſphoric acid, fuſed with ſuch cryſtals upon the coal, was at the beginning tinged with a topaz-yellow; but, after a little nitrate of pot-aſh had been detonated on the heated mixture, the ſaline maſs aſſumed a fine amethyſt-red colour.

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* *Eſtner*, Verſuch einer Mineralogie. Wienn. III. Band. I. Abth. pag. 84.

B.

a) Three hundred grains of Saſſolin left a light-grey reſidue of 56 grains weight, on being diſſolved in a ſufficient quantity of ſpirit of wine. After ſlow evaporation the liquor afforded, till the end, cryſtals of *boracic acid.*

b) Thoſe 56 grains of reſidue, boiled with a large quantity of water, left 16 on the filter. When this aqueous ſolution had been concentrated by evaporation, it gradually depoſited *ſulphate of lime*, in needle-ſhaped cryſtals, weighing 8½ grains.

c) On continuing the evaporation, more of the cryſtals, already mentioned, appeared: and moſt of them were tetrahedrons with ſtrongly truncated terminations, or rhomboids with ſharp edges. The weight of all thoſe cryſtals together conſiſted in 31½ grains. On treating their aqueous ſolution with cauſtic ammoniac, a light-brown precipitate enſued; which, while yet moiſt, was digeſted with a cauſtic lye. But this took up nothing of it. It was then again ſeparated from the liquor and waſhed; upon which its colour turned darker on the filter, and by all experiments, made with it, it was found to be a ſomewhat iron-ſhot mangaueſe. Therefore, thoſe 31½ grains of cryſtals muſt be conſidered as *ſulphate of mangane ſe.*

d) Thoſe 16 grains of earth, which the water would not diſſolve, were farther decompoſed, by means of acids, into 8 grains ſilex, 5 grains carbonated lime, 2 grains alumine, and 1 grain of oxyded iron mixed with mangaueſe. But ſince this earth can be conſidered only as adventitious,

ous, it ſhould be ſubtracted; which done, their remain for the conſtituent parts of *Saſſolin* in one *hundred*,

Boracic acid	86
Sulphate of Manganeſe, containing a little iron	11
Sulphate of lime	3
	100

* * *

With the above analyſis of the *native boracic acid*, I examined at the ſame time that aſh-grey, arenaceous powder, mixed with ſome ſhining micaceous points, which accumulates on the lakes, from the waters of which that acid depoſites, and which has been ſent to me under the name, *Loto*.

a) Water, faintly tinged blue with tincture of litmus, was reddened by introducing a ſmall portion of that powder.

b) One *hundred grains* of that powder were expoſed to digeſtion with 4 ounces of ardent ſpirit. The ſpirit of wine, again ſeparated by means of the filter, gave no indications of the preſence of boracic acid;—on the contrary, a ſmall trace of ſulphate of lime appeared.

c) That powder was then elixiviated with water in a boiling heat. The water emitted a ſmell of ſulphurated hydrogen, and a ſilver-plate put into it became much tarniſhed. This water alſo contained an uncombined acid; which, as in conſequence of the experiment juſt now mentioned *b)* it cannot be the boracic, conſiſts, perhaps, merely of that principle. On evaporating the water, *ſulphate of lime* parted from the liquor in ſlender needles; which, together with that obtained from the ſpirit of wine, weighed 5 grains.

d) The elixiviated powder, which after deſiccation in a moderate temperature weighed 84 grains, was ſpread out upon a ſmall, flat, gently heated pot. A portion of *ſulphur* deflagrated; by which the mentioned weight ſuffered a loſs of 8 grains.

e) What remained of that powder, was ignited with twice its weight of pot-aſh, ſaturated to exceſs with muriatic acid, evaporated to ſome degree of dryneſs, and again diſſolved in water; upon which *ſiliceous earth* ſeparated, which, collected and ignited, weighed 54 grains.

f) The filtered fluid was then accurately neutralized by the addition of more pot-aſh, and combined with *ſuccinate of ſoda*. The precipitate, obtained by this management, conſiſted of 3 grains of *oxyded iron*, after ignition.

g) Upon the remaining liquor a cauſtic lixivium was affuſed; which gave a precipitate, that again diſſolved on adding a ſlight over-proportion of the alkali. But after ſaturating the liquor with an additional quantity of muriatic acid, this re-diſſolved portion of the precipitate was again recovered by means of carbonated ſoda, and proved to be *aluminous earth*; which, when ignited, had 16 grains in weight.

This ſandy ſubſtance, therefore, contains in the *hundred*:

Silex	54
Alumine	16
Oxyd of iron	3
Sulphur	8
Sulphate of lime	5
	86

The ſmall portion of ſulphurated hydrogen, indicated in the experiment *c*), cannot well be eſtimated. But there is no doubt, that the greateſt part of the loſs of weight is to be attributed to the water combined with this foſſil, and volatilized by the heat applied in the above analytical proceſſes.

LXXXI.

CHEMICAL EXAMINATION

OF THE

PLUMOSE ALUM.

(Feder-Alaun)

FROM FREYENWALDE.

THE *Plumoſe Alum* (Sulphate of Alumine), which is ſpontaneouſly generated upon the *aluminous ſlate* (Alaunſchiefer of *Werner*) at *Freyenwalde*, in the Margraviate Brandenburg, partly in the mines themſelves, but principally during the withering of that ſlate upon the declivities of the mountains is, when freſh, of a greyiſh-white, but in the air it acquires a dirty-yellow coating. It exhibits an aggregate of ſubtle, capillary, and moſtly curvilinear fibres; which in part are accumulated in looſe bundles, partly concreted in a cruſtaceous manner. It poſſeſſes a moderate luſtre, has a ſilky appearance, and is commonly opake.

a) Of this plumoſe alum I diſſolved in water one *hundred grains* taken from pure ſpecimens, and decompoſed the ſolution with *carbonate of ammoniac*. The ſmutty pale-bluiſh precipitate, thence obtained, I transferred, while yet moiſt, into a lye of cauſtic ſoda, and applied a heat of ebullition. An *oxyd of iron* remained behind, which edulcorated and ignited, weighed 9¼ grains. But as the iron is contained inth is ſpecies of ſulphated alumine in an oxyded ſtate, that weight muſt be reduced to 7½ grains.

b) To the alkaline liquor I added *ſulphuric acid*, till the precipitate formed on the firſt affuſions was re-diſſolved. This done, I precipitated the aluminous earth by means of carbonated ſoda. The weight of this *alumine*, after it had been waſhed and heated to redneſs, was 15¼ grains.

c) The lixivium remaining after the firſt precipitation with ammoniac *a*), was evaporated, and the dry ſalt expoſed to a red-heat, until the ſulphate of ammoniac, which it contained, was entirely driven out. The ſmall reſidue of ½ grain, left in this proceſs, I found to be ſulphate of pot-aſh. When diſſolved in a little water and treated with a ſolution of tartareous acid, it formed regenerated tartar. As for the mentioned ½ grain of ſulphated pot-aſh, we can reckon only half that quantity of *pure pot-aſh*, the conſtituent parts of the *plumoſe alum* here examined bear to each other, in *one hundred*, the proportion, as follows:

Alumine	15. 25
Oxyd of iron	7. 50
Pot-aſh	0. 25
Sulphuric acid, and *Water of cryſtallization*	77.
	100

LXXXII.

CHEMICAL EXAMINATION OF THE *CAPILLARY SALT FROM IDRIA.*

(*Haarſalz* of the Germans.)

THE *capillary ſalt* (Halotrichium by *Scopoli*) which i the Mercury-mines at *Idria* is found in the clefts of a ſhiſtoſe clay or ſhale (*Schieferthon*), intermixed with aluminous ſlate, occurs of a ſilvery-white colour, and forms ſometimes capillary filaments and needle-ſhaped cryſtals, of a ſilky luſtre, above 2 inches long.

It has hitherto been taken for *plumoſe alum*; becauſe, according to *Scopoli* *, it is ſuppoſed to conſiſt of vitriolic acid, alumine or argil, calcareous earth and iron. The falſity of this opinion will be rendered manifeſt by what follows.

A.

a) One *hundred parts* of this ſalt readily diſſolved in 100 parts of cold water, without any reſidue, nafforded and limpid tion. I diluted this ſolution with more water, and dually dropped diſſolved carbonate of ammoniac into it, long as any turbidity enſued. The iron, which by this atment was thrown down in looſe, dirty olive-green ks, I ſeparated by filtering; upon which the clear liquor ibited all the properties of any other ſolution of pure *phate of magneſia.*

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* *Scopoli* Principia Mineralogiæ, p. 81. §. 105.

ſolution.

b) The *one half* of this ſolution was precipitated with a of cauſtic ſoda; a large quantity of the ſame lixivium s then ſuperadded, and the whole boiled together. The id, ſubſequently to this, diluted with water and filtered, as next neutralized with *ſulphuric acid*, and treated with *rbonated ſoda*; but neither any precipitation nor cloudineſs ok place, which evidently proves the total abſence of uminous earth.

c) The *other half* of that ſolution, freed from its con-nts of iron, was precipitated in a boiling heat by means *carbonate of ſoda.* The precipitate obtained, was a re *carbonate of magneſia.*

B.

One *hundred grains* of the capillary ſalt were expoſed, a crucible, to a ſtrong red-heat for half an hour. When moved from the fire, it preſented a dull white, and in me places a pale reddiſh colour; it alſo had moderately aleſced, though it was ſtill diviſible into ſingle filaments. diſſolved this maſs in water, collected on the filter the parated oxyd of iron and ignited it. The weight of this ſt, including the aſhes of the filtering paper, was only ½ f a grain.

The ſolution, now freed from iron, and precipitated in a temperature of 212° Far., with carbonated ſoda, gave grains of carbonate of magneſia after deſiccation in a gentle warmth. It again clearly re-diſſolved in ſulphuric acid, weakened with water, and wholly ſhooted into cryſtals of *ſulphate of magneſia*.

By theſe experiments, therefore, it is demonſtrated, that the *capillary ſalt* from *Idria* is not a *plumoſe alum*, and contains neither alumine, nor lime; on the contrary, that it is a *native ſulphate of magneſia*, defiled by a ſlight portion of ſulphated iron.

LXXXIII.

CHEMICAL EXAMINATION OF THE *ELASTIC BITUMEN*;

From Derbyſhire.

MONG the inflammable ſubſtances of the Mineral
gdom, the *elaſtic bitumen*, or *mineral Caoutchouc*, as it
lled, from the lead mine *Odin*, near *Caſtleton*, in *Der-*
re, is eminently diſtinguiſhed by that very remarkable
erty which is indicated by its denomination. *Charles*
chet, *Eſq.* * on deſcribing this foſſil, enumerates 15
eties of it, of which thoſe comprized in the firſt nume-
contain *petroleum*, partly yet in a fluid ſtate; while
of the laſt paſs into perfectly indurated, friable *aſ-*
tum. But thoſe deſcribed in the intermediate numeros,
ſs elaſticity in various degrees. From this ſpecies,
her differs, which only a few years ſince has been
d in a ſmall river in the vicinity of the above-men-
ed lead-mine; both by a peculiarly modified elaſticity,
other properties, by which in ſome manner it reſem-
cork. Of this Mr. *Hatchet* mentions 5 varieties.

f thoſe in my collection, I ſhall notice only the 4 fol-
ng varieties.

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* Scherer's Journal der Chemie. Numb. xxi. pag. 282.

1) Elaſtic bitumen, maſſive and pure, of a *browniſh olive green*; which, when held againſt the light, is ſemi-pellucid, and of a bright hyacinth-red. It is ſoft, very elaſtic, and ſticks cloſely to the finger.

2) *Dark-brown* elaſtic bitumen, reſting on and between the cryſtals of a grey, ſpathoſe, bituminous, carbonate of lime (*Stinkſtein, Swine-ſtone*).

3) *Yellow* and *bright-hyacinth-red* elaſtic bitumen, which is diſſeminated, in ſmall maſſes, in a ſtony aggregate mingled of fluate of lime and calcareous ſpar.

4) *Reddiſh-brown*, dull, ſponge, or cork-like elaſtic bitumen, with knobs of black-grey aſphaltum (*Schlackiges Erdpech*).

In the experiments which I ſhall now relate, I employed the pure elaſtic bitumen of No. 1.

The elaſtic bitumen belongs to thoſe ſubſtances, the analyſis of which can be attempted in the *dry way* only; and where, conſequently, we muſt renounce the hope of obtaining pure *educts*, that is to ſay, of ſeparating all their conſtituent parts ſingly, in a ſtate of purity, and of aſcertaining their proportions with ſtrict preciſion.

A.

a) It reſiſts in general all liquid menſtrua, of all of which the rectified *petroleum* ſeems to exert upon it the greateſt agency. Pieces of that bitumen covered with this fluid, were after ſome days found a little ſwelled, and rendered tranſparent. The fluid, before colourleſs, had been tinged with a bright yellow.

) Upon another portion I poured *fuming nitric acid*, d lodged it in a ſand-bath. On the application of heat a ſhort while, the red fumes ceaſed, making room for ite vapours which ſucceeded them, and continued until moſt the whole of the acid had gone off by evaporation ; hich ſhews, that no reciprocal action has taken place. fter the bitumen had been waſhed, no change was per- ived in it.

c) Nor is it leſs remarkable that the *alkalis* proved abſo- tely inefficacious. One part of the bitumen was intro- ced into 16 parts of a ſtrong, *cauſtic*, alkaline lixivium, d boiled with it for ſome time till the cauſtic ſalt was arly dried up. But the lumps of the bitumen employed, hen freed by waſhing from the adherent alkali, were und to poſſeſs their former conſiſtence, colour, and elaſ- city in the ſame degree as before the proceſs.

B.

A portion of the elaſtic bitumen was ſet on fire, and ept in a ſtate of combuſtion till it melted into black drops. ven in this condition it had not loſt all its elaſticity ; it as ſtill adheſive, and could be drawn into filaments be- veen the fingers. By this management, however, it was *ndered ſoluble* in petroleum and other oils, and gave with em ſolutions of a blackiſh cloudy tint.

C.

a) Two hundred grains of pure elaſtic bitumen were in- oduced into a ſmall glaſs-retort, lodged in a ſand-bath, d connected with the pneumatic quickſilver-apparatus, pon this I proceeded to diſtillation, to perform which an intenſe and pretty long continued heat was requiſite. The *products* gained by this proceſs were:

1) *Four and eighty cubic inches of a gas*, which gave out an offenſive ſmell, like garlick. Of this gas, waſhed with water, 8 cubic inches were abſorbed by the latter; and theſe ſhewed to be *carbonic acid gas*, by precipitating a proportionate quantity of carbonated lime. The remaining 76 cubic inches; burned with a ſtrong flame, in the capacity of *carbonated hydrogen gas.*

2) A *brown*, thin, fluid *oil*, of an unpleaſant odour, and 146 grains of weight.

3) A weakly *acidulous water*, of no more than 3 grains of weight. Its quantity being ſo ſmall, it was not poſſible to inveſtigate the nature of the acid it was impregnated with.

b) The looſe coaly reſidue in the retort, of a ſomewhat metallic luſtre, weighed 24 grains.

1) When incinerated upon a teſt, this reſiduum left 13 grains of reddiſh-brown aſhes; theſe, moiſtened with water, reſtored the blue colour to litmus paper previouſly reddened by an acid, which, probably, was owing to ſome cauſtic lime contained in thoſe aſhes. On digeſting them with muriatic acid, there remained 4½ grains of a light grey earth, mixed with ſome coaly particles; and, upon a ſecond ignition, 3 grains of a fine *ſiliceous earth* were left behind. Hence the whole quantity of the conſumed *carbon* had amounted to 12½ grains.

2) The muriatic ſolution was reduced by evaporation, and on diluting it with a weak ſpirit of wine, 1 grain of *ſulphate of lime* ſeparated in delicate cryſtals. The

ſame ſolution, diluted with more water, and treated with ſuccinate of ammoniac, yielded a reddiſh precipitate, which after ignition gave 1½ grains of *oxyded* iron. But the remainder of the fluid, neutralized with cauſtic ammoniac, afforded ½ grain of *aluminous earth*. This laſt being filtered off, 7¼ of carbonated calcareous earth, equal to 4 grains of pure *lime*, were obtained from the liquor by means of carbonate of ammoniac.

Conſequently by this method of analyſis have been obtained from one *hundred parts* of the examined *elaſtic bitumen*:

Carbonated hydrogen gas	38 cubic inches.
Carbonic acid gas	4 ———
Bituminous oil	73 grains.
Acidulous water	1. 50
Carbon	6. 25
Lime	2.
Silex	1. 50
Oxyd of iron . . . -	0. 75
Sulphate of lime . , ...	0. 50
Alumine	0. 25

But of theſe, only the laſt 5 conſtituent parts can be conſidered as *educts*. The firſt 5 ſubſtances were *products*, generated from the change which the fire had effected in the *carbon*, *hydrogen*, *and oxygen*, that entered into the natural mixture or compoſition of the elaſtic bitumen, and ought, therefore, to be conſidered as its *proximate conſtituent parts**.

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* Cfr. *gren.* Principles of Modern Chemiſtry, 8. Lond. 1800. Vol. I. §. 7.—10.———Tranſl.

To conclude: From the reſult of this analyſis nothing can be inferred, that might lead towards a ſatisfactory explanation of the ſingular elaſtic property of this ſpecies of bitumen. On this account it ſeems, at preſent, neceſſary to reſt ſatisfied with the opinion of Mr. *Hatchet*, according to which that elaſticity is ariſing either from a portion of air, or from ſome other elaſtic fluid, which is contained between the pores of this bitumen, and during its natural generation accumulates there, and imparts to the whole maſs a ſpongy nature,

LXXXIV.

CHEMICAL EXAMINATION

OF

MELLILITE[*].

(*Honigſtein.*)

A.

THE foſſil, which only ſince the laſt ten years has become known under the name, *Mellilite*, belongs to thoſe of which the nature and chemical conſtituent parts have not yet been ſufficiently inveſtigated, and the ſyſtematic claſſification of which is, for this reaſon, ſtill uncertain. Mr. *Werner*, of Freiberg, was the firſt who introduced the exiſtence of this foſſil into public notice, and it is alſo from him that it received the name which at preſent is given to it.

Mellilite occurs at *Artern*, in Thüringia, though but ſparingly and ſingly, in the ſtratum of the earthy Brown-coal *(Braunkohle* of *Werner)*, of that place. Its external characteriſtic properties are the following:

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[*] Read at the Royal Academy of Sciences at Berlin, on the 13th of June, 1799.

It commonly poſſeſſes a *honey-yellow* colour, in various gradations as to brightneſs or darkneſs, and from this colour its name* was choſen; but ſometimes it exhibits only a pale ſtraw-yellow.

It always occurs cryſtallized, and more eſpecially the *firſt variety*, in ſomewhat inclined *octahedrons*. Yet it is but ſeldom met with in perfect cryſtals of that form; moſt frequently it is found in fragments of more or leſs diſtinct quadrilateral pyramids. The *ſtraw-yellow variety* forms ſmall *druſy aggregations*. Cryſtals of a middle ſize are not often found, not even of the honey-yellow variety; they are moſtly but ſmall, decreaſing to the very minute.

The *ſurface* of mellilite is commonly even and ſplendent; in part alſo rough and corroded. But internally a dulliſh gloſs is obſerved. *Fracture* of the flat conchoidal kind; the fragments indeterminately angular.

Its cryſtals are ſeldom clear, in moſt ſpecimens only ſemi-pellucid, and thoſe of the pale-yellow variety hardly tranſparent.

Mellilite is ſoft, brittle, readily yields to the peſtle, and grinds to a yellowiſh-grey powder. Its ſpecific gravity equal to 1.550.

In the earthy brown-coal at *Artern*, there alſo now and then occurs a native ſulphur, in ſeparate, ſmall, pale-yellow cryſtals. Theſe, with reſpect to their external appearance, ſhew a great ſimilarity to the ſtraw-yellow mellilite; for which reaſon ſome attention is requiſite, leſt both theſe foſſils be confounded with each other.

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* *Honey-ſtone*, the Engliſh expreſſion for mellilite.

The

B.

The firſt conjecture formed on the nature of mellilite, was to conſider it as an inflammable foſſil, reſembling amber (*ſuccinum*), which ſuppoſition ſeemed to be juſtified in ſome manner by its external form. But if the character of an inflammable foſſil, that does not belong to the claſs of metals, conſiſts in the capability of furniſhing, out of its own ſubſtance, aliment to fire; mellilite is very little qualified for that purpoſe. For, it turns only white by burning, without being capable of maintaining the fire. Nor can it be ſaid, that mellilite is a cryſtallized amber, as *Born* preſumed in his *Catalogue de Mademoiſelle de Raab.* The falſity of this opinion has been demonſtrated by the experiments of *Gillet-Laumont* *.

Others have conſidered mellilite as *gypſum* (ſulphate of lime), impregnated with and tinged yellow by petroleum. This error has, undoubtedly, been occaſioned merely by its being rendered white by the fire. On the other hand, it is not impoſſible, from the ſcarcity of this foſſil, that ſomewhere artificial cryſtals of the figure of thoſe of mellilite have been cut out of a ſimilar ſpathoſe gypſum, and fraudulently offered as ſuch.

C.

A more accurate chemical knowledge of this foſſil could be expected only from its perfect decompoſition. Such an analyſis has actually been undertaken, not long ago, an nearly at the ſame time, by two reſpectable chemiſts, Pro feſſor *Lampadius*, at Freiberg, and Mr. *Abich*, at Schö pingen; each of whom publiſhed an account of his ex periments, yet with a very material difference in the re ſults.

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* Journal de Phyſique, 1791. Pag. 370.

According to *Lampadius*, 100 parts of mellilite con ſiſt of:

85. 50	*Carbon.*
3. 50	*Petroleum.*
2	*Silex.*
5	*Water of cryſtallization Abrich.*
96.	

Whereas Mr. *Abich* ſtates the following proportion of its conſtituent parts:

40	*Carbonic acid.*
28	*Water of cryſtallization.*
16	*Carbonate of Alumine.*
5	*Benzoate of Alumine.*
5. 50	*Benzoic acid.*
3	*Oxyd of iron.*
2. 50	*Reſinous matter.*
100	

This ſtriking difference in the ſtated component principles could not fail to ſuggeſt the ſuſpicion of an error committed in either of theſe two analyſes; and, conſequently, to excite a deſire of another new and complete examination of that foſſil.

Being enabled, by the poſſeſſion of a quantity of mellilite ſufficient for inſtituting and repeating experiments, by which its nature might be diſcloſed; I took this taſk upon me, and ſhall here lay before the Public the reſult of my inquiries.

D.

Preliminary Experiments.

1) Mellilite, placed on an ignited charcoal, or held in the flame of a candle, loſes its tranſparency and yellow colour; it grows white, ſpotted with black, and at length perfectly as white as chalk. Smoke or flame are not obſervable in this treatment.

2) If mellilite finely pulverized be long boiled with a ſufficient quantity of water, a decompoſition is effected; the water acquires properties of an acid, and leaves a light-grey ſlimy earth behind.

3) Mellilite in entire ſpecimens, when thrown into *nitric acid*, diſſolves without heat, and within a few minutes is totally taken up by this ſolvent; the pieces continue clear until the diſſolution is accompliſhed. This property furniſhes an eaſy expedient, to diſtinguiſh genuine mellilite from ſuch ſubſtances as, perhaps, may be fraudulently offered for it.

4) When put into *muriatic acid*, the pieces of mellilite continue not clear as they do in the nitric, but aſſume a whitiſh turbidneſs; they alſo were not wholly diſſolved after the end of ſeveral days.

5) Pieces of mellilite conveyed into *ſulphuric* acid, do not ſink, but float immerſed in the fluid up to their ſurface.

face. By degrees they fall into whitiſh flocks, without affording a clear ſolution; though this is obtained after diluting the acid with water.

6) Concentrated *acetic acid*, with which mellilite was covered and left ſtanding for a certain time, had no effect upon it.

7) In the *cauſtic lye of ſoda*, affuſed upon pieces of mellilite, its integrant particles ſeparated in the form of white flocks; the greateſt part of which gradually diſſolved.

8) Other pieces of the ſame foſſil, which I immerſed in *cauſtic ammoniac*, likewiſe became gradually divided into flocks; they would, however, not diſſolve.

9) Mellilite was alſo tried with *nitrate of pot-aſh*, which had previouſly been ſo far brought to a ſtate of ignited fuſion, that a piece of charcoal projected into it cauſed a vivid detonation. But no actual detonation took place, when the mellilite was thrown into it, its ſeveral pieces only glimmered away like hot embers, with a faintiſh irradiation of light, which ſoon ceaſed; and they divided themſelves, in the melted nitre, in the form of a white earth.

E.

Guided by theſe previous inveſtigations, I proceeded to the following *more accurate experiments*.

1) I mixed 50 grains of powdered mellilite with 75 grains of cryſtallized *carbonated ſoda*, and boiled the whole with a ſufficient quantity of water in a matraſs. A mutual re-action ſoon took place, accompanied by a moderate effer-

veſcence from the diſengagement of the carbonic acid of the ſoda. After the decompoſition of the mellilite had been brought about, by means of this alkali, I collected the earthy reſiduum on the filter, waſhed, and ignited it. It weighed 8¾ grains, and was alumine. The ſoda employed for this decompoſition, was found neutralized, as to its greateſt part, but not entirely. For this reaſon I ſaturated the ſtill predominant part of it with *acetic* acid, and evaporated the mixture to dryneſs in a low heat. The aceated ſoda, produced by this combination, I ſeparated by repeated affuſions, little at a time, of ſpirit of wine upon the ſaline maſs, diſſolved the reſiduum in water, and ſet the ſolution by to cryſtallize. Solid cryſtals of a neutral ſalt ſhooted to the formation of which, therefore, the mellilite has furniſhed the acid conſtituent part.

Hence from this experiment it reſults, that mellilite conſiſts of alumine and an acid.

2) Upon *fifty* grains of powdered mellilite I poured *cauſtic ammoniac*, ſtoppered the veſſel, and agitated it from time to time. After 24 hours I found the foſſil decompoſed, and the bottom of the glaſs-veſſel covered with a quantity of ſmall, heavy, cryſtalline grains of a neutral ſalt, which had been formed by the combination of the acid of the mellilite with the ammoniac. Upon theſe cryſtals the aluminous earth, which had been ſeparated by the decompoſition of the foſſil ſettled in the form of a light, browniſh ſlime. This mixture I warmed, diluted it with a quantity of water ſufficient to re-diſſolve the cryſtals of the ſalt, and threw it on the filter. When the clear ſolution was again evaporated to ſome degree, the whole of it gradually ſhooted into ſmall, thin, ſix-ſided priſms.

3) *Fifty* grains of coarſely pounded mellilite were treated with *diluted ſulphuric acid.* It was ſoon taken up by the ſolvent. Only a little brown ſlime was left from the particles of the earthy brown-coal adhering to it, and, beſides, a few cryſtallic grains of ſand; which laſt, therefore, do not belong to the component parts of mellilite, but are to be conſidered as adventitious. The filtered ſulphuric ſolution, by being concentrated with the aſſiſtance of heat, coagulated to a ſoft ſaline maſs, beautifully ramified with minute acicular cryſtals, without any indication of ſolid cryſtals of alum; which ſhews, that no pot-aſh is contained in mellilite.

F.

Decompoſition of Mellilite in the dry way.

1) One *hundred* grains of mellilite, in the pureſt ſelect ſpecimens, were coarſely broken, and introduced into a ſmall retort of glaſs, which, by means of a tube, blown out in the middle to a concave ſphere, was connected with the mercurial pneumatic apparatus. As ſoon as the retort was heated by the gradual approach of burning coals, a gas paſſed over, which I caught in four cylindrical glaſs jars filled with mercury. At the ſame time water came over and condenſed in the mentioned intermediate globe. Towards the end of the diſtillation a little drop alſo of a congealed pale-yellowiſh oil appeared on the orifice of the retort. But no trace was perceived of any ſaline ſublimate or coating. The foſſil changed by degrees its colour, and at the end of the proceſs aſſumed a perfect black.

2) The collected aeriform fluid amounted to 74 cubic inches, of which, after ſubtracting 7 cubic inches for the atmoſpheric air that filled the interiour capacity of the diſ-

tilling

ling apparatus, 67 cubic inches of gas remain as the pro- ct of the diſtillation. As ſoon as the jars were opened lime water, a rapid abſorption of the gas they contained ok place, and carbonate of lime was generated. In the ſt jar 7 cubic inches of mere common air remained. The s contained in the ſecond veſſel was entirely abſorbed: it of that of the third and fourth, 13 cubic inches were ft unabſorbed, which could readily be ſet on fire, and ntirely burned, with a fine ſky-blue flame. On deducting eſe 13 cubic inches of *inflammable gas* from the 67 ob- ined, the quantity of *carbonic acid gas* produced in this peration, is 54 cubic inches.

3) The water collected in the ſpheric part of the tube as limpid, without colour, and weighed 38 grains. It nitted a ſweet, and fragrant odour, mixed with the ſmell f bitter almonds, which laſt, after ſome time, became ſtill ore perceptible. That water alſo indicated the preſence f an acid, by faintly reddening blue litmus paper.

That minute drop of oil, mentioned 1), ſeemed to poſ- ſs a ſimilar odour; its taſte alſo was rather ſweetiſh and omatic, than participating of empyreuma.

4) As to the reſiduum in the retort, it was black and reſplen- nt like jet *(gagat)*; and the pieces of the foſſil had pre- rved their original ſize and figure. It weighed 25 grains. eated to redneſs upon an open teſt, it gradually diſcharged at black hue, and aſſumed a dull yellowiſh-white: Its eight was now brought down to 16 grains. *Sulphuric id* readily diſſolved it to a ſlight reſidue of iron and ſilex, d afforded with it, on the addition of acetated pot-aſh, yſtals of ſulphated alumine. Hence the *carbon*, conſumed ring the ignition of that reſiduum, with the acceſs of air, nounted to 9 grains of weight.

Thoſe *hundred* grains of *mellilite*, therefore, ha by this method of analyſis, in the *dry way*,

54 cubic inches of *carbonic acid gas.*
13 . . . . . *pure hydrogen gas.*
38 grains of *weakly acidulous and aromatic*
1 . . . . *aromatic oil.*
9 . . . . *pure carbon.*
16 . . . . *alumine united with ſome ſilex.*

It thus reſulted from this decompoſition, that th *conſtituent part* which is combined with the earthy b mellilite, is not a ſimple mineral acid, but an aci poſed of carbon, hydrogen, and oxygen, and, conſeq a *vegetable acid* deſtructible by fire.

G.

Decompoſition of Mellilite by means of Wa

To ſeparate the *acid of mellilite*, and to preſent it in its unaltered native ſtate, I was enabled by the f ing method:

1) *Four hundred* grains of moſt finely ground me were thrice boiled in a matraſs for two hours, wi ounces of diſtilled water each time. There remai light, ſlippery, earthy reſidue of 210 grains weight drying.

2) The filtered fluid was concentrated by evaporatio water-bath. It thickened to a browniſh maſs of a ſwe ſour taſte, ending in a bitteriſh. Upon this I pour the cold, ſpirit of wine, in which it acquired at firſt a pitchy conſiſtence, but diſſolved on continued tritur

t length greyiſh-white, light, earthy flocks were de-
oſited, weighing 22 grains when ſeparated by filtration.
he ſolution, freed from this reſidue, was evaporated in a
ater-bath to perfect dryneſs; after which it preſented
ſelf as a browniſh-white maſs, of a greaſy feel, but ſtill
ulverizable, and weighed 92 grains.

3) This *acid of mellilite*, purified by alkohol, afforded
with cold water a clear, pale-browniſh ſolution, which I
nſpiſſated afreſh in a water-bath. It now diſplayed a
ryſtalline, needle-ſhaped form, which became more diſ-
inct, after the maſs had a ſecond time been diſſolved in
water and expoſed to ſpontaneous evaporation. Upon this
management the dry acid, partly exhibited an accumulated
maſs of ſmall globules of a light-grey colour, and diſpoſed
n a concentrically-radiating manner; partly it had ſhooted
nto ſhort, detached needles.

4) Thoſe 210 grains of earthy reſide left on the decom-
oſition of mellilite by means of water 1), together with
hoſe 22 grains of earthy flocks which were ſeparated by
he means of alkohol 2), were expoſed to a red-heat; dur-
ng which proceſs they emitted a weak, ſweetiſh, but diſ-
greeable ſmell, ariſing from the combuſtion of a ſmall
uantity of the acid, ſtill adhering to the earth. What
emained after ignition, reſembled a mixture of a grey-white
with a browniſh powder, amounting to 64 grains. This
eſidue, treated with a quadruple weight of *concentrated ſul-*
huric acid, became hot of its own accord, and, ſoon after,
he mixture coagulated into a white, granularly cryſtal-
ized maſs of ſalt, which, when diſſolved in water and
ltered, left on the paper a grey, incoherent, earthy reſidue
f 11 grains weight upon ignition. Theſe 11 grains I
igeſted with *muriatic acid*, which thereby became tinged
ith yellow; here *ſiliceous earth* remained, weighing 5½

grains when waſhed and ignited. I then combi
muriatic ſolution, freed from this earthy ingredien
Pruſſian alkali, and obtained a deep-brown precipit
of ſo ſlight a quantity as hardly to indicate ⅛ g
oxyded iron. From the remaining liquor ſome
was thrown down by carbonate of ſoda.

This alumine re-diſſolved in ſulphuric acid, wi
to the preceding ſulphuric ſolution 4) and both
evaporated to a ſmaller volume; they formed only
unctuous ſaline coagulum. But on diluting it wit
and adding acetate of pot-aſh, the whole of the
ſhooted, in the ſucceſſive evaporations and cryſtalli
into cryſtallized ſulphate of alumine; which by ſo
boiling water and decompoſition, by means of ca
ammoniac, yielded 58 grains of waſhed, dried, an
alumine.

H.

By the reſults of theſe inveſtigations, which alſ
ſtance, were obtained the ſame in repeated exp
it is rendered evident, that mellilite conſiſts of
combination of alumine and an acid; and, at the ſa
that this acid is not a ſimple mineral, but of th
of vegetable acids. Whether it, however, oug
annumerated to any of the vegetable acids alread
or whether it ſhould be taken for a peculiar mo
of thoſe principles, the union of which conſtitutes
acids, and, conſequently, whether it ſhould be
as a peculiar, diſtinct vegetable acid, was yet
decided by a more appropriate and rigorous exami
its properties.

1) The *acid of mellilite* cryſtallizes in finely-ſi

ericaIly accumulated maſſes, or alſo in minute ſhort umns. Yet this diſpoſition to cryſtallize it does not m directly to poſſeſs when firſt ſeparated from its com- iation with alumine, but to acquire it by degrees only; bably by taking up more oxygen from the atmoſphere.

2) Its taſte is ſweetiſh-ſour, at the beginning, but ends a bitteriſh.

3) Placed upon a *heated teſt*, it is rapidly decompoſed, ith the diſengagement of a thick, dark-grey ſmoke; hich, however, little affects the organs of ſmell. It then ſo leaves behind a ſmall quantity of light, yellowiſh aſhes; e water with which they are moiſtened continues taſteleſs, d produces no change, neither in the blue nor in the ddened litmus-paper.

4) When neutralized with *pot-aſh*, it forms a longiſhly iated cryſtalline maſs.

5) Its neutral combination with *ſoda* ſhoots partly in a bical form, partly in trilateral plates, which ſometimes ſingle, and ſometimes ſtellularly accumulated.

6) The neutral ſalt ariſing from its ſaturation with *am- niac*, repreſents clear, hexagonal priſms, which ſoon part ith their tranſparency on expoſure to dry air, and then ume a ſilvery-white appearance.

7) If acid of mellilite diſſolved in water be dropped into ſolution of *cauſtic lime*, or *barytes*, or *ſtrontian*, it imme- tely produces a white precipitate, which again directly ſappears on dropping a little muriatic acid into the uor.

8) On

8) On mixing this acid with a ſolution of *acetated bary* a white, and in nitric acid again ſoluble precipitate is likewiſe obtained.

9) The *muriated* ſolution of *barytes* cauſed no turbidneſs or precipitation; but a ſhort while after very minute, clear, acicular cryſtals were found in the mixture.

10) Diſſolved *nitrate of ſilver* continued limpid on the addition of the acid of mellilite.

11) From the *nitric ſolution of mercury*, whether prepared in the cold or with the aſſiſtance of heat, a copious precipitate was thrown down; but this again readily diſſolved in the nitric acid, ſuperadded.

12) *Iron diſſolved in nitric acid*, alſo produced a conſiderable, iſabella-yellow precipitate; which, like the preceding, again clearly diſſolved in the muriatic acid, which I afterwards poured into the mixture.

13) *Acetate of lead* is, in the ſame manner, ſtrongly precipitated by the acid of mellilite, but clearly re-diſſolved on adding nitric acid.

14) With *acetate of copper* it afforded a precipitation of the colour of verdigris.

15) Diſſolved *muriate of copper* ſuffered no change.

16) My attempt to convert the acid of mellilite into the *oxalic*, by means of reiterated treatments with nitric acid, was not crowned with ſucceſs; the only change effected by them was, that its browniſh-white colour turned to a ſtraw-yellow. The precipitate, which I procured from lime-water

ter with the acid of mellilite after it had undergone
oceſſes, inſtantly yielded to the nitric acid added by
which could not have been the caſe, had any portion
acid, newly generated, been preſent.

I.

theſe habitudes and properties of the acid of mel-
iſcovered by the preceding experiments, yet well
g a farther inveſtigation, it is now ſufficiently ob-
that this acid enters into a combination with ſeveral
nd metallic oxyds; and alſo that its attraction to,
ther words, its affinity with theſe ſubſtances, is
than that of the acetic; but, on the contrary,
than that of the mineral acids.

ſame reſults are obtained, if, inſtead of the un-
d acid of mellilite, its neutral combinations be
d. The precipitates produced are in part ſoluble in
ter.

, therefore, the acid of mellilite preſents itſelf as
compounded of oxygen, carbon, and hydrogen,
this reaſon, of an eaſy deſtruction by fire, at the
e that, with reſpect to its habitudes and proper-
agrees with none of the acids hitherto known; it
ell deſerve to be claſſed among the acids of vege-
gin, as a *diſtinct acid*, or *of a peculiar nature*; and,
preſent, with no other name, but, *Acid of Mel-*

what place ought to be aſſigned, in the ſyſtematic
tion, to *Mellilite*; it being the firſt inſtance in

nature of a combination of alumine with a vegeta —The mineral kingdom might object to its requ among its products, on the ground that mellilite owe origin to the vegetable kingdom; as is fufficiently pro both from its occurence in a ftratum of the earthy brow coal, and from the vegetable nature of its acid.—Notwi ftanding this, its very occurrence in the mentioned co (a fubftance, which, though originally an offspring of t vegetable kingdom*, yet, after its vegetable death h become the property of the foffil kingdom,) entitles t Mineralogift to affociate the mellilite with the mine- rals; fo much the more fo, as its bafis, the alumin earth, unqueftionably appertains to the mineral kingd alone.

K.

Finally, what concerns the proportion of the conftituent parts in mellilite, I was not yet able to afcertain it with perfect accuracy; particularly for this reafon, that, by the related experiments, it cannot be well determined; whether any, or what part of the water, that was obtained on decompofing this foffil in the dry way, muft be reckoned among the *products*. But if, for the prefent, the water be confidered as an *educt* only; then, after fubtracting the 38 parts of water, and 16 of alumine, from the 100 parts of mellilite decompofed (F), the remainder 46 will give the proportion of its ingredient acid, and this proportion is confequently to be fought for in the weight of the products of the decompofed acid *(cit.)*; *viz.* the ic acid gas, the hydrogen gas, and the carbon, er with the ſlight portion of oil.

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* The analyfis of it has been given by the Author in Effay cxv.

llilite, therefore, conſiſts of:

Mellilitic acid	46
Alumine	16
Water of cryſtallization . . .	38
	100

LXXXV.

CHEMICAL EXAMINATION

OF

UMBRA.

(Umber.)

FORMER mineralogiſts commonly notice, under the name *umbra*, a brown pulverulent earth, which with the genuine umbra has nothing in common but the colour. The firſt conſiſts of an earthy brown-coal, and may eaſily be known by its glimmering in the fire to aſhes. On this account *Cronſtedt* calls it, *mumia vegetabilis*, and *Wallerius*, *humus umbra.*

Genuine umbra, on the contrary is incombuſtible, and, if regard be had to its conſtituent parts, belongs to the ores of iron: among which it may juſtly be ranked as a variety of the *ochraceous brown iron-ſtone.*

The only analyſis of this foſſil, I know of, is that which has been publiſhed by *Santi* of the umbra from *Caſtel del Piaro:* the conſtituent parts of which he thus accounts for: *Oxyd of iron* 53, *argillaceous earth* 24, *ſilex* 19, *magneſia* 4. —But ſince *Santi* mentions no manganeſe, though it is an eſſential co-conſtituent part of umbra; this circumſtance ſeems to render the accuracy of his ſtatement doubtful.

The umbra employed in the experiments that follow, mes from the iſland *Cyprus*. In its external characters it rees in every reſpect with that ſort, which is ſold, in mmerce, for the purpoſes of painting, and known by the me of *Fine umbra from Turkey*; ſo that a farther de- ription of theſe properties would be unneceſſary.

A.

a) Umbra loſt 14 *per cent.* of weight, by ſuſtaining a d-heat for half an hour; the only other change it ſuffered this, is, that its colour had paſſed into a more ſaturate rk-brown.

b) In a ſtronger heat, on the contrary, umbra enters into ſion. Of its habitudes in the fire of the porcelain fur- ace, in the *charcoal-crucible* as well as in the *clay-crucible* have already given an account *.

For the purpoſe of inſtituting a new experiment, I put a iece of umbra weighing 200 grains into a crucible made of n excavated charcoal, and ſubmitted it to the intenſe fire f the porcelain furnace. Examining the contents of the rucible, which returned unimpaired from the fire, I found, nder a hard, clear, light hyacinth-red, and on the exterior ſurface, extremely fine punctulated ſcoria, a well fuſed metallic button, which externally appeared partly reticulated, proved ſomewhat tenacious on breaking it with the hammer, and exhibited a ſteel-grained texture. The metallic button weighed 80 grains, and the vitreous ſcoria 47; the loſs of weight, therefore, amounted to 36½ *per ent.*

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* See Eſſay I. page 32.

B.

One *hundred* grains of finely pulverized umbra were mixed with 200 grains of *concentrated ſulphuric acid*, evaporated to dryneſs, and briſkly ignited in a crucible. The ignited maſs was found of a brick-red colour, little coherent, and readily yielding to the peſtle. After elixivation with water, and filtering, the liquor poſſeſſed a light-brown colour, and contained ſulphate of manganeſe.

C.

One hundred grains of triturated umbra were digeſted in a boiling heat, with *muriatic acid*. The reſidue, which eſcaped the ſolution, heated to redneſs, weighed 19 grains. The fluid filtered off and previouſly reduced by evaporation, was treated with a concentrated ſolution of *tartrite of potaſh*; but the mixture continued clear. A precipitation was then attempted by means of a lixivium of ſoda; however, in this inſtance likewiſe, no precipitate, nor turbidneſs was produced; and the mixture exhibited a liquor of a full, dark brown-red colour. Upon this it was ſaturated to a ſmall exceſs; by which management it again became brighter. Its precipitation was now again, but unſucceſsfully, attempted with cauſtic ammoniac: for the mixture again aſſumed the juſt now mentioned dark brown-red, without any cloudineſs that could be diſcerned.

This experiment was made with a deſign to ſeparate the manganeſe from the iron; but it miſcarried. On the other hand it ſerved to confirm a *property*, which is *peculiar*

to

the tartareous acid: namely, that, by its acceſſion or con-rrence, iron is rendered ſoluble in liquid alkali.

D.

a) I poured upon one *hundred* grains of umbra a ſolution F 200 grains of *cauſtic ſoda*, inſpiſſated the mixture to dryeſs, and ignited it moderately for half an hour. The aſs gave, by diffuſion in water, a fine deep emerald-green xivium, the colour of which was changed by muriatic cid to an amethyſt-red. When the lye had been fully turated with acid, the whole of the maſs diſſolved to a ellow-red fluid, and oxygenated muriatic acid gas eſcaped. now evaporated the mixture to a moderate dryneſs, toards the end of which proceſs it acquired a gelatinous onſiſtence. Upon ſubſequent dilution with water, it left *liceous earth* on the filter, of 13 grains weight when igited.

b) Diſſolved *cauſtic ſoda* was then added in exceſs to hat ſolution, and the dark-brown oxyd of iron, thrown lown by the alkali, ſeparated by filtering and elixiviated. The fluid that paſſed the filter, was neutralized with ulphuric acid and precipitated with carbonate of pot-aſh. *Aluminous* earth fell down, amounting to five grains after gnition.

c) The oxyd of iron, when dry, had the appearance of a ſhining black pit-coal. Heated to redneſs, it weighed 68 grains. It was rediſſolved in muriatic acid, and the ſolution being carefully put in the moſt perfect poſſible ſtate of neutralization, was precipitated with *ſuccinate of ammoniac*. After filtering off the ſuccinated iron, I precipitated the remaining colourleſs fluid together with the large quantity of water, uſed to edulcorate the ſwelled precipitated ſuccinate, by cauſtic ſoda in a boiling heat. The blackiſh-brown, looſe precipitate, when waſhed and ignited, aſſumed a dark browniſh-black, and weighed 20 grains. It was an *oxyd of mangane ſe*. Its quantity ſubtracted from the 68 grains before mentioned *c*), left 48 grains for the true proportion of the ingredient *oxyd of iron*.

According to this, the conſtituent parts of *umbra* in the hundred are:

Oxyd of iron	D. c)	48
Oxyd of mangane ſe	c)	20
Silex	a)	13
Alumine	b)	5
Water	A. a)	14
		100

LXXXVI.

CHEMICAL EXAMINATION

OF THE

MURIATED LEAD-ORE.

THOUGH various mineralogical writers have men-
d a *muriated lead-ore*; yet its exiſtence has never been
ed. Among others, chiefly the cryſtallized lead-ores
Mies and *Przibram* in Bohemia, have been conſidered
native muriated lead *(plumbum corneum)*; but on ex-
ing it repeatedly, I diſcovered, that partly the carbonic,
y the phoſphoric acid are its mineralizers; and, on the
rary, of muriatic acid I found no trace in it.

owever, by the following analyſis the exiſtence of a
ve muriated lead-ore, is now placed beyond all doubt.
ſmall portion which I poſſeſs of it, I have received
the reſpectable promoter of mineralogical knowledge,
honourable Thomas *Greville* of London: with the re-
k, that it had been found in *Derbyſhire*, ſeveral years
; but is now ſcarce, thoſe mines being not worked at
ent.

o the deſcription of its external characters, which Mr.
ſten has drawn up from the ſpecimens ſent to me and
liſhed *, I add, that the regular cryſtals of this muriated

Karſten: Mineralogiſche Tabellen. Berlin, 1800, page 78.

lead are cubes of the ſize of from ⅛ to ½ inch, with truncated edges; and that, by the diverſity of theſe truncations, ſeveral variations are produced in the external figure of its cryſtals.

As ſoon as this muriated lead, heated upon charcoal with the blow-pipe, comes in contact with the exterior point of the flame, it runs into an opake globule with a ſurface of a reticular appearance, and of an orange-colour; which on cooling paſſes through the intermediate lemon-yellow into the white. But when the coal or that part of it on which the globule reſts, is glowing, the globule ſuddenly diffuſes, the muriatic acid flies off in white vapours, and the coal is covered with grains of metallic lead.

A.

a) I triturated *fifty* grains, from ſelect pure ſpecimens, of the muriated lead-ore, with three parts of the pureſt carbonate of pot-aſh * I was able to procure, and expoſed the mixture, in a platina-crucible, to a moderate red-heat. The maſs, which appeared ſtraw-yellow, I elixiviated and filtered. It left, on the paper, a white and pretty looſe *oxyd of lead*, which I deſiccated and heated till it began to aſſume a yellow tinge. In that ſtate it weighed 42

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* In order to obtain ſuch pure pot-aſh, free from any traces of admixed muriatic acid, I diſſolved purified nitre in water and precipitated it with nitrate of ſilver. I then evaporated the clear ſolution to dryneſs, and *alkaliſed* the nitrate of pot-aſh thus obtained, in a crucible of poliſhed iron, by means of an ignited charcoal. The diſſolved and filtered lye, after it was neutralized with nitric or acetic acid, gave no indications of any turbidneſs on dropping into it nitrate of ſilver.

grains,

ains, and was eaſily reduced on the charcoal to pure re-
line lead.

b) The alkaline lixivium was in a ſmall degree ſuper-
urated with *nitric acid* and upon this precipitated with
rate of ſilver. The muriate of ſilver then obtained,
hen collected, waſhed and dried with the aſſiſtance of
at, weighed 27 grains: which indicates a little more
an 4 grains of *concrete muriatic acid* *.

B.

a) Upon *hundred* grains of the muriated lead-ore, finely
ulverized, was poured *nitric acid* largely diluted. The
id attacked the ore, even in the cold, with a moderate
xtrication of *carbonic acid gas.* On warming the men-
ruum, all the ore diſſolved and afforded a clear, colourleſs
lution.

b) This ſolution, ſufficiently diluted with water, I gra-
lually combined with a ſolution of nitrated ſilver: care-
ully obſerving not to exceed the proper proportion. The
weight of the muriate of ſilver, that was thus thrown
own, amounted to 55 grains, when properly edulcorated,
nd highly dried. For theſe 55 grains of muriated ſilver,
ve muſt put in the account 8½ grains of *concrete muriatic*
cid.

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* Or, as *Kirwan* calls it, *real* acid. Chemiſts well know, that
e cannot obtain the muriatic acid free from water: but in che-
ical proceſſes and inveſtigations it is ſuppoſed to be ſo, as is here
e caſe. The *elaſtic* or aeriorm ſtate of this acid has no concern
ith the preſent ſubject.—Tranſl.

c) The lead contained in the remaining fluid was precipitated, in a warm temperature, by means of *cauſtic* potaſh. The *oxyd of lead* procured, well waſhed and briſkly deſiccated, conſiſted in 85½ grains of weight.

From the reſults of this analyſis, which very nearly agree with thoſe of the laſt preceding, the conſtituent parts of the *muriated lead-ore* and their proportion to each other, are to be ſtated thus:

Oxyd of lead	85. 50
Muriatic acid	8. 50
Carbonic acid, including the water of cryſtallization, perhaps preſent	6
	100

In the muriate of lead prepared by art, the proportion of the acid amounts to from 13 to 14 *per cent.* But, in the native muriate of lead, the metallic conſtituent part is not quite perfectly ſaturated with the muriatic acid. This explains, how in this laſt, beſides the muriatic, carbonic acid alſo may be preſent.

LXXXVII.

CHEMICAL EXAMINATION

OF THE

PHOSPHATED LEAD-ORES.

I.

Siſkin-green Lead-ore from Zſchopau.

A.

THAT the *green ore of lead* from the mine *Heilige Dreifaltigkeit*, at *Zſchopau*, contains phoſphoric acid as a conſtituent part, I have already ſtated in a previous notice in the year 1784 *, and proved it to be ſo by the analyſis which I publiſhed of this ore in the year 1785 †. This ore occurs cryſtallized either ſingly or in irregularly accumulated ſix-ſided columns, without pointed terminations. Sometimes their length is from 1 to 2 inches; moſt frequently they are of a ſmaller ſize. Its colour is the green of olives or of the ſiſkin, which ſometimes paſſes to the graſs-green, and often alſo to the whitiſh-yellow. By trituration it yields a ſtraw-coloured powder. The ſurface of the cryſtals, if pure, is ſmooth and of a greaſy gloſs; but commonly they are covered with a firmly adhering ferruginous cryſtallized figure, with brilliant facets. are commonly found minute grains of n the whole of it is not reduced without a perty of aſſuming after fuſion, upon ch tioned form of cryſtals without becom green ore from Zſchopau poſſeſſes in comn known phoſphated lead-ores, as well as w of lead artificially prepared. The ſame already been obſerved by *Cronſtedt*, on ex lead from a place unknown to him *.

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* *Crell*, Chemiſche Annalen, 1784, page 394.

† Beyträge zu den chemiſchen Annalen. I. B. 2 St. page 13.

2) To be brought to fuſion this lead-o ſiderable heat. For, after I had expoſe under a muffle to the ſame degree of heat pellation of gold very well ſucceeds, I f not melted, and had undergone no change angles of its cryſtals were a little rounde trary, when acted upon by a ſtrong meltin furnace, it entered into perfect fuſion an cooling in a ſtriated form: almoſt like which it alſo reſembled in colour.

empyreumatic ſmell, and reddening paper tinged blue with litmus, ſettled around the orifice of the veſſel in the form of ſmall drops of dew. The powder acquired, by this heating, a colour of a more greyiſh caſt. With reſpect to its weight, no loſs was obſervable; whence it muſt be inferred, that the weight of the expelled acidulous moiſture has been recovered by a like quantity of oxygen attracted from the air. I mixed this powder with one ounce of black flux and half a drachm of brown roſin *(colophony)*, introduced it into an aſſay-crucible filled up with charcoal-duſt, covered the whole with a ſmall portion of common ſalt, and left it for half an hour in a melting heat. On opening the veſſel, I found moſt of the interior parts of the ſcoria coloured reddiſh; and the reduced lead had an excavation, the origin of which, namely, a commencement of volatilization of the lead, was ſoon rendered conſpicuous by the minute, ſhining globules of lead which coated the lid of the crucible. The weight of the lead obtained was no more than 2 drachms 12 grains; hence there is no doubt, but alſo a part of the metal had eſcaped through the hole in the lid of the veſſel.

4) *a*) *Two ounces* of this ore, finely pulverized, were now diſſolved in *nitric acid* previouſly weakened with 3 parts of water and aſſiſted by a boiling heat. The reſidue conſiſted of a light, bright-yellow ochre weighing, 14 grains; twelve of which obeyed the magnet after ſome fat had been deflagrated upon it. The clear, colourleſs ſolution was diluted with more water, and its portion of lead precipitated by means of ſulphuric acid. The weight of the ſulphate of lead thus obtained, indicates 11 drachms and 32 grains of metallic lead.

b) The fluid, now freed from the ſulphated lead, I evaporated in a ſand-heat, until it no longer diſcharged any perceivable vapours, and had acquired the conſiſtence of oil. It was *phoſphoric acid* diſengaged from the lead-ore; and, when brought to its appropriate degree of concentration, it weighed 3 drachms and had a colour inclining to a weak olive-green. I diluted it with water and combined it, by turns, with ſoda and ammoniac until it was ſaturated; upon which it was evaporated to the point of cryſtallization. By this management I obtained, on ſucceſſive evaporations and cryſtallizations, 280 grains of an artificial *microcoſmic ſalt*, as it is called (*phoſphate of ſoda and ammoniac*). The firſt ſhootings afforded perfectly white and pure cryſtals; but, towards the end, the colour of this ſalt, as well as of the vitreous pearl into which I fuſed it, inclined a little to the green. When no more concrete ſalt would ſhoot in the muddy and thickiſh mother-liquor, I mixed it with water, and ſeparated, by means of the filter, a white ſlimy earth, which, in the dry ſtate, weighed 10 grains, melted into a tenacious fluid upon the charcoal with a phoſphoric ſhine, and at laſt rounded itſelf to a bright, greeniſh glaſs-pearl. From the remainder of that liquor, Pruſſian alkali has precipitated pruſſiate of iron, which after ignition weighed 1¼ grains, and was wholly attractible by the magnet.

B.

From the reſults of the foregoing experiments, the exiſtence of the phoſphoric acid in this lead-ore has, indeed, been fully proved: yet, in order to aſcertain its proportion with greater accuracy, I repeated the analyſis of it in the manner as follows.

a) One *hundred* grains of the ſiſkin-green variety of the lead-ore from Zſchopau, previouſly pulverized and ſeparated

rated by elutriation from the adhering light ochre, diſſolved in dilute *nitric acid* with which they were digeſted in a boiling heat, without leaving any reſidue and gave a colourleſs ſolution.

b) The acid moiſture, found on the neck of the retort on heating the ore A. 3.). induced me to ſuſpect the preſence of a ſmall portion of muriatic acid. This conjecture was confirmed by the reſult: for, nitrate of ſilver dropped into it, inſtantly produced a precipitate conſiſting of muriated ſilver. When this precipitant cauſed no farther cloudineſs, I placed the mixture in a warm temperature, and, after it had become clear, I collected, waſhed and dried that muriate of ſilver. It weighed 11 grains, of which 1. 70 grains muſt be reckoned for the *concrete muriatic acid.*

c) To the ſolution *a) ſulphuric acid* was added, as long as, in a warm temperature, any precipitation enſued. The ſulphate of lead ariſing from this combination, being collected on the filtrum, elixiviated, and heated to redneſs in a crucible made of platina, amounted to 106 grains: equivalent to: 73. 61 metallic lead, or to: 78. 40 *oxyd of lead.*

d) In order to free the fluid, from which the lead had now been removed, from that portion of ſulphuric acid which before had been added in exceſs, I combined it with a ſolution of *nitrate of barytes.* And, when the addition of this laſt no longer produced any turbidity, I filtered the ſolution and added ſuch a quantity of ammoniac as would bring it nearly, but not totally, to the point of neutralization. Upon this I ſeparated the phoſphoric acid by precipitation with *acetate of lead.* The phoſphate of lead then formed, waſhed and moderately ignited in a platina crucible, weighed 82 grains: which determine the proportion of the *concrete phoſphoric acid*, combined with tha to 18. 37 grains.

e) What ſtill remained of that ſolution, was mixed wi a little *muriatic acid*, and inſpiſſated to a moderately d ſaline maſs: which I treated with ſpirit of wine. Af this had been decanted, I evaporated it entirely, rediſſolv the ſmall dry reſidue in water, and tried it with *pruſſia pot-aſh*. A blue precipitate enſued, but in ſo ſmall a quant that it could not well be collected. However, ſince the preceding analyſis the quantity of oxyded iron, whi belongs to the compoſition of this ore and is the effici cauſe of its colour, has amounted only to 1½ grain i ounces of the ore A. 4. *b)*, and ſince even from this ſ quantity we muſt yet deduct the ſlight portion of iron tained in the Pruſſian alkali; the whole of the *oxyd of* contained in 100 grains of the ore cannot be eſtimate more than: 0.10 grains.

Therefore, the conſtituent parts of this *green lea* from *Zſchopau* give in one *hundred*:

Oxyd of lead	78. 40
Phoſphoric acid	18. 37
Muriatic acid	1. 70
Oxyd of iron . . . . :	0. 10
	98. 57

II.

Graſs-Green Lead-ore from Hoffsgrund.

The *green lead-ore from Hoffsgrund*, near Freiberg, i territory of Briſgaw, and particularly diſtinguiſhed l bea beautiful *graſs-green* colour ſhews, in every reſpect, the ſame habitudes with the ore from Zſchopau. Only in the proportions of its conſtituent parts I diſcovered an unimportant difference.

a) *Hundred* grains of this ore, in very pure ſpecimens, left on ſolution in dilute *nitric acid* ½ grain of the quarzoſe matrix *behind*; which I ſeparated and replaced by an equal quantity of pure ore. The colourleſs ſolution, treated with nitrate of ſilver, yielded 10 grains of muriated ſilver: which indicates 1.54 of *concrete muriatic acid*, contained in 100 of the ore.

b) In the next inſtance, the ingredient lead was ſeparated by means of *ſulphuric acid*. The collected ſulphate of lead, after gentle ignition, weighed 104½ grains; for which 77.10 grains of *oxyded lead* muſt be put in the account.

c) When after this the nitric ſolution had been freed, by nitrated barytes, from the portion of ſulphuric acid added to exceſs, and ſubſequently treated with ammoniac ſo far, that the acid ſtill predominated, I continued adding a ſolution of acetated lead, till no more turbidneſs was effected. The generated phoſphate of lead, when collected and expoſed to a gentle red-heat, proved to weigh 85 grains; and conſequently, the proportion of the *phoſphoric acid* muſt have been 19 grains.

d) The remaining fluid was mixed with *muriatic acid*, the mixture evaporated to dryneſs, and extracted with ardent ſpirit. The reſidue, after completely evaporating the ſpirit, was again diſſolved in water, and treated with Pruſſian alkali. A precipitation of pruſſiated iron enſued, the quantity of which, by the eye, ſeemed to be equal to that obtained from the Zſchopau lead-ore.

From the reſults of this decompoſition it follows, the conſtituent parts of the *green lead-ore from H* and their proportion to each other, are:

Oxyd of lead	77.	10
Phoſphoric acid	19.	
Muriatic acid	1.	54
Oxyd of iron	0.	10
	97.	74

III.

Brown Lead-ore from Huelgoët.

The *phoſphated lead-ore* which occurs in the lead-mines at *Huelgoët* in the çi-devant French Bretagne along with the ſulphurated lead-ore *(galena)* differs, as to its external appearance, from the preceding, *firſt*, by a greater magnitude of its cryſtals which are ſix-ſided columns, and *ſecondly*, in this, that it is found ſeldom of a green, but moſt frequently of a brown or reddiſh-grey colour. It is alſo on this account, that it is mentioned in the later mineralogical ſyſtems as a diſtinct ſpecies with the name of: *brown lead-ore.* A variety of this foſſil is met with in the ſame mines, cryſtallized in very thin and ſhort needles, which partly exiſt ſingly, partly are accumulated in groups.

The brown lead-ore ſubjected to the following examination, has been broken off from a ſpecimen, that is made up of ſix-ſided columns concreted in a parallel manner, of the thickneſs of a common writing pen, and 1½ inches long. The ſpecific gravity of thoſe cryſtals I found to be: 6.600.

eſcaped the action of the leſs ſolution, when treated of muriated ſilver, which muriatic acid.

n preſented to the ſolution. ned in that fluid, in the ca-h having ſuſtained a red-heat, hich 80 grains of *oxyd of lead*

ceſſes, ſo was in this the exceſs rom the fluid, by means of ni-ne, I added ammoniac in ſuch greater part of the fluid, and, pitated the phoſphoric acid with 80 grains, which is the amount obtained, the proportion of the tering into the compoſition of the ains.

the fluid contained nothing more of the foſſil, excepting a ſlight veſtige

undred parts of this *yellow lead-ore* re reſolved into,

. . . . 80.
. . . . 18.
. . . . 1. 62

99. 62

our of this ore ſeems to ariſe merely from

Another *brow* [illegible] of oxydation of
ingly, at *Schem* [illegible] be pulverized,
ſmall, and in [illegible] poured upon it in a
form a compli [illegible] its yellow colour,
feſs of it bein [illegible]
perimenting [illegible]
its examin [illegible]
bitudes h [illegible]
contains [illegible]

V.

[illegible] *white Lead-ore.*

[illegible] also examined a *greyiſh-white ore*
[illegible] thin columns of a ſtrong
[illegible] found it to be a *phoſphated*
[illegible] of 4½ parts of *oxyd of lead* to 1
[illegible] as its analyſis has been carrie
T [illegible] that of the preceding ores, I
H [illegible] give a detailed account of it.
lu [illegible] foſſil comes is unknown to me:
e [illegible] more regret, becauſe the phoſphate
o [illegible] found of a white colour.

* * *

[illegible] the analytical proceſſes, which
[illegible], may contribute towards eſtabliſh
[illegible] claſſification of lead-ores, in *minera*
[illegible] on *chemical principles*; at the ſame
[illegible] ſhews the impropriety of derivi
[illegible] foſſils from their colours.

[illegible] *muriatic acid* in the phoſphated
[illegible] remarkable, and it is not leſs ſo that, up
[illegible] to the phoſphoric acid is con
[illegible] foſſils.

LXXXVIII.

CHEMICAL EXAMINATION OF THE SULPHATED LEAD-ORES.

I.

ulphated lead-ore, or the native ſulphate of lead from *riſh Mountain*, in the iſland of *Angleſea*, occurs in an urated brown ochre, in ſmall ſingle cryſtals, the are of which appears to be an oblique quadrilateral py- aid. Theſe cryſtals are often entirely clear and colour- , but moſt frequently they are tinged brown by a fine raceous inveſtment. The luſtre of their interior ſur- e is that of the diamond.

I found the ſpecific gravity of this foſſil equal to: 6.300.

When in entire pieces, it decrepitates upon the char- l, in the moment that the flame is directed to it with blow-pipe; but, when previouſly pulverized and placed the ſame ſituation, it melts to a reſplendent ſcoria, which, continued ignition, is reduced to metallic lead.

a) One *hundred* grains of this ſulphate of lead were ited in a covered crucible. On the very firſt impreſſion of [illegible] with a lively [illegible] from [illegible] weight. This loſs, [illegible] which [illegible] the expelled water of cryſtallation [illegible] the ſake of a trial, nitric acid [illegible] glaſs [illegible] of ore pulverized for the purpoſe. white [illegible] leaſt indication of air-bubbles [illegible] [illegible] ore was reduced to a fine powder, [illegible] of *carbonated pot-aſh*, and [illegible] red-heat in a platina crucible. The [illegible] withdrawn from the fire, exhibited a [illegible] moderately baked together. It was [illegible]vered with water and expoſed for a while [illegible]; after which the greyiſh-white [illegible] ſeparated during this digeſtion, was [illegible] This oxyd, when edulcorated and [illegible] of platina, at a degree of heat [illegible] to make it fuſe, weighed 72 grains.

[illegible] lead was diſſolved in dilute *nitric acid*; [illegible] 1 grain of oxyded iron ſeparated, which, [illegible] be ſubtracted from the mentioned 72 [illegible] a cylindrical piece of zinc [illegible] the lead ſettled around it in beautiful la- [illegible] a metallic vegetation. After the whole [illegible] precipitated by this means, it was [illegible] and dried with proper care to pre- [illegible] In this ſtate its weight was 66½ [illegible]

[illegible] fluid *a)* was a little ſuperſaturated with [illegible] this, combined with *acetate of ba-* [illegible] of barytes generated by the combi- [illegible] earth with the ſulphuric acid contained ed in this liquor, amounted to 73 grains after waſhing ignition.

nce in 100 parts of ignited ſulphate of barytes, the real uric acid conſtitutes 34 parts, it follows by calculation for thoſe 73 grains of the obtained barytic ſulphate we ſet down 24.80 grains of *concrete ſulphuric acid.*

he proportion, therefore, of the conſtituent parts diſ-red by this method in the *cryſtallized* native *ſulphate ad* from *Angleſea* gives for the *hundred:*

Oxyd of lead	71.	
Sulphuric acid	24.	80
Water of cryſtallization . . .	2.	
Oxyd of iron	1.	
	98.	80

he portion of iron contained in this ore, can hardly onſidered as an eſſential conſtituent part; it is pro-y but adhering to its exterior ſurface, or only mecha-lly admixed.

II.

lphated Lead-ore, from Lead-hills, in Scotland.

he preceding foſſil from *Angleſea* has hitherto been only one known *native ſulphate of lead.* From the wing analyſis it will appear, that beſides this ſpecies ead-ores, there exiſts another, which, as to the com-nt principles, agrees with the firſt, but differs from it in the external appearance by being cryſtallized in *thick plates* or tables. In other reſpects, it is diveſted of all colour; the greater part of its maſs is tranſparent, and it poſſeſſes a diamond-luſtre in an eminent degree.

It occurs at *Wanlock-head*, near *Lead-hills*.

Its habitudes upon the charcoal, before the blow-pipe, are the ſame as thoſe exhibited by the preceding ſpecies.

a) One *hundred* grains of this *tabular* native ſulphate of lead in ſelect pure ſpecimens loſt 2¼ grains, by being heated in a covered crucible. When finely pulverized and ignited in a platina-crucible with 400 grains of *carbonate of pot-aſh*, they yielded a browniſh-yellow, moderately concrete maſs. Upon this ſubſtance, previouſly triturated, water was affuſed and heat applied to promote the ſolution of the ſoluble parts. As in the caſe of the preceding foſſil, ſo in this an *oxyd of lead* depoſited from the liquor, which, when waſhed, dried and moderately ignited, weighed 70½ grains. Dilute *nitric acid* took the whole of it up without the aſſiſtance of heat and afforded a clear ſolution, from which the lead has been precipitated in the reguline ſtate, by means of *zinc*. The metallic lead, thus obtained, when collected, waſhed and quickly dried, amounted to 65½ grains.

b) In order to aſcertain the quantity of ſulphuric acid contained in the alkaline ſolution, it was combined with *nitric acid* added to ſuper-ſaturation in ſome degree, and, in the next inſtance, treated with *acetate of barytes*. By this management ſulphate of barytes was formed and precipitated, to the amount of 76 grains, after being heated to redneſs: which indicates 25¾ grains of *concrete ſulphuric acid*.

According

ccording to this decompoſition, *hundred* parts of the lar *ſulphate of lead* from *Lead-hills* conſiſt of:

Oxyd of lead	70. 50
Sulphuric acid	25. 75
Water of cryſtallization	2. 25
	98. 50

LXXXIX.

CHEMICAL EXAMINATION

OF THE

TABULAR WHITE LEAD-ORE.

From Lead-Hills.

At *Lead-hills*, in Scotland, alſo occurs another *white, tabular lead-ore*, cryſtallized in *hexagonal plates*; which ſhould not be confounded with the native tabular ſulphate of lead, treated of in the preceding eſſay. For, in the firſt, the lead is mineralized by *carbonic acid*, while, in the ſecond, it is combined with the ſulphuric.

The ſpecific gravity of this foſſil was equal to 6.480.

a) One *hundred* grains of it, in pure ſpecimens, and previouſly triturated to a powder, were by ſmall portions introduced into a mixture of 200 of *nitric acid* with 300 grains of water, and put in equilibrium upon the balance. The ore diſſolved readily, and with a ſtrong effervefcence, without *leaving* any reſidue. By the carbonic acid that eſcaped, a loſs of 16 grains of weight was cauſed.

b) The ſolution, which was clear and colourleſs, was diluted with water, and a cylinder of zinc put into it. After 24 hours, the whole of the lead had ſhooted in beautiful metallic laminæ, which collected, waſhed, and both quickly and carefully dried, to the end that no oxydation

might

t take place, afforded 77 grains of *lead in the reguline* , which correſpond with 82 grains of *oxyded lead.*

onſequently, the conſtituent parts of this *tabular* and *onated white lead-ore*, bear to each other the following ortion :

Lead	77.
Oxygen	5.
Carbonic acid	16.
Loſs, including the water of cryſtallization, if any preſent	2.
	100.

XC.

CHEMICAL EXAMINATION

OF THE

NATIVE REGULINE ANTIMONY

From Andreaſberg.

THE exiſtence of the *native* or metallic *antimony*, in the bowels of the earth, was firſt diſcovered by *Swab*, in the ſilver-mine at *Sala*, in Weſtmannland, where it occurs ſparingly diſſeminated in calcareous ſpar. Before *Swab* had examined this foſſil more cloſely, it was erroneouſly taken for arſenical pyrites [*], (native arſenic alloyed with iron).

More recently, in the year 1780, native antimony has alſo been found in the mines of the mountainous diſtrict of *Chalanges*, near *Allemont*, in the department de l'Iſere in France. According to the information which Mr. *Schreiber* [†] has given of this fact, there were found of it about *two* centners in two different places; but after this no more of it was met with. There alſo, this foſſil was firſt conſidered as an arſenical pyrites, until *Sage* [‡] examined it, and declared it to be reguline antimony, alloyed with 16 *per cent.* of arſenic. But, according to *Mongez* the younger, who likewiſe inveſtigated its nature and confirmed it to be antimony in the metallic ſtate, its portion of arſenic amounts only to 2 or 3 *per cent*: beſides, in his opinion, the arſenic does not belong to the natural compoſition of this foſſil, but ought to be conſidered as but caſually admixed.

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[*] Abhandlungen der Schwediſchen Academie. For the year [illegible].

[†] Journal de Phyſique. May, 1784.

[‡] Memoires de l'Academie des Sciences. Paris, 1781.

To theſe two places, where nature furniſhes antimony in its reguline ſtate, without the acceſs of art, I add a third: namely, the mine *Catharine Neufang*, at at *Andreaſberg*, on the Harz. A few years ago a conſiderable quantity of it was there diſcovered: of which, being taken for antimoniated ſilver, a great part was put into the melting furnace, before the error was perceived, and the remainder conſidered as a mineralogical rarity worth preſerving.

Its colour is a tin-white inclining to the lead-grey. It is maſſive, of a ſtrong metallic luſtre, of a curvilinear and thin-foliated fracture. It preſents ſeparate pieces both of a coarſe and a fine grain; is ſemi-hard, and ſoft. Its ſpecific gravity I found to be: 6.720.

In the mine it is accompanied by calcareous ſpar, quarz, the red ſilver-ore *, &c.

A.

Treated with a blow-pipe it behaves exactly in the ſame manner, as antimony reduced by art from its ores reguline ſtate. It rapidly melts to a globule and volatilizes in the form of a grey inodorous ſmoke, which depoſits on contiguous cold bodies as a white integument. If the melted metallic button be ſuffered to cool ſlowly; it is afterwards found inveſted and ſurrounded with white, brilliant, acicular, that is, needle-formed cryſtals. But if by means of the bellows it be blown off or diſſipated, while in the ſtate of fuſion, it leaves a ſmall bead of ſilver behind.

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* For the analyſis of this conſult Eſſay IX. of this work, page 124.—Tranſl.

B.

a) Upon one *hundred* grains of pulverized, and pure native antimony from Andreaſberg, I affuſed *nitric acid*; which, on the application of heat, attacked it with vehemence and ſoon converted it into a white oxyd. When on the addition of a freſh quantity of acid no more red vapours aroſe, I diluted the mixture with water, filtered and combined it with muriatic acid. Muriated ſilver fell down, which upon reduction gave 1 grain of *metallic ſilver*. The reſidual nitrated liquor contained nothing elſe, but about ¼ grain of iron, ſeparated by means of Pruſſian alkali.

b) The greyiſh-white oxyd of antimony, that had been left on the filter, was covered with *muriatic acid* aſſiſted by a gentle heat; it eaſily diſſolved in it without turbidneſs. This ſolution when diluted with *ſix* parts of water, let fall a white precipitate; which again clearly diſſolved in the muriatic acid added afreſh, and from this laſt menſtruum was precipitated as *metallic antimony* by introducing a piece of *zinc*. The quantity of this antimony, waſhed and dried amounted to 98 grains.

hus the *hundred* grains of *native antimony* from *An- ſberg* have been decompoſed into:

Metallic antimony	98.	
Silver	1.	
Iron	0.	25
	99.	25

t is probable, that the portion of ſilver is only by chance tained in this foſſil.

XCI.

CHEMICAL EXAMINATION

OF THE

ANTIMONIATED SILVER

From Andreaſberg.

The *antimoniated ſilver*, dug in the mines at *Andreaſberg*, is one of thoſe minerals, which, by its rich contents in ſilver, has, for a number of years paſt, been ſo profitable to the ſmelting-works of that place. But concerning the other metallic ingredient, which it contains beſides the ſilver, an error has long prevailed: for, this co-conſtituent part having been taken for arſenic, it was not poſſible to diſtinguiſh the foſſil, here under examination, from the *arſenico-martial ſilver-ore*, which likewiſe though leſs frequently occurs in thoſe mines, and of which I have already given the analyſis *.

In the analytical inquiry to be now deſcribed, I have employed that maſſive, cryſtallized, foliated and grained variety of the antimoniated ſilver, which ſeveral years ago was worked in the mines at Andreaſberg: and which, not only in the external characters, but alſo in its richneſs in ſilver very nearly agrees with the antimoniated ſilver, in fine grains from the *Wenzel's mine*, at *Altwolfach*,

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* Eſſay IX. Sect. VIII. page 158.

in

n the territory of Furſtenberg *. Its ſpecific gravity is 820.

I.

a) Upon charcoal, before the blow-pipe, it enters into fuſion only at a ſomewhat higher degree of ignition. On continuing the blowing, its antimonial part entirely flies off in vapours and leaves a bead of pure ſilver.

b) Twenty-five grains ſubjected to cupellation with 4 grains of lead, upon a cupel made of wood-aſhes, yielded 19¼ grains of *fine ſilver*.

II.

a) One *hundred* grains of the antimoniated ſilver were digeſted with *nitric acid*. The action was violent. Boiling heat was applied as long as any red vapours appeared, and till the reſidue was perfectly oxyded. The mixture was left to cool, then mixed with water, and filtered.

b) To this nitric ſolution *muriatic acid* was affuſed, and the muriate of ſilver, thus produced in a large quantity, was elixiviated, and rendered very dry. It weighed 102 grains. The remaining fluid contained a ſlight trace of iron.

c) Upon the reddiſh-white reſidue, left by the nitric acid, I affuſed *muriatic acid* which, with the aſſiſtance of a low heat, readily diſſolved it. At the bottom of the veſſel appeared 1 grain more of muriated ſilver; which,

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* See Eſſay LXVIII. page 561.

being

[illegible] [illegible], I diluted the ſolution with 6 parts [illegible] and added as much muriatic acid as was requiſi[illegible] the limpidity of the liquor, diſturbed by the di[illegible]. Upon this I introduced a poliſhed plate of iro[illegible] precipitated from it the *antimony* in the *regulin*[illegible] the amount of 22½ grains after waſhing and de[illegible]

[illegible] to theſe reſults, the conſtituent parts of this [illegible] variety of the *antimoniated ſilver* from the *Harz* may [illegible] thus:

Silver	77.
Metallic *Antimony*	23.
	100

* * *

Perhaps this publication of the analyſis of the antimoniated ſilver from Andreaſberg might well have been con[illegible] diſpenſed with, on the conſideration that we already poſſeſs one given by Mr. *Abich* *, the reſults of which, upon the whole, agree with thoſe of the preceding.

[illegible] determines the conſtituent parts of the ſpecimen, [illegible], in the proportion of:

Silver	75. 25
Antimony	24. 75
	100

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* In Crell's Chemiſche Annalen. 1798. Vol. II. page 3.

That, which I decompoſed, was, therefore, a little richer in ſilver.

However, beſides that my inveſtigation may ſerve to confirm that of *Abich*, I am induced to publiſh mine by a late example of neglect in making the due diſtinction between the antimoniated ſilver, and the arſenico-martial ſilver-ore (*arſenic ſilver* of *Werner.*) I allude to *Jordan's mineralogical chemical obſervations, &c.* Gottingen, 1800, page 279, where this error has been committed, and to *Scherer's Journal of Chemiſtry,* number 26, page 235, where it is repeated by way of extract. Had *Jordan* examined his imaginary arſenical native ſilver, he would have found that the particular conſtituent part which eſcaped during cupellation, was not arſenic, but antimony: as has been already mentioned by that judicious connoiſſeur of the minerals from the Harz, Mr. *Abich*, in *Scherer's* Journal, 29th number, page 664.

XCII.

CHEMICAL EXAMINATION

OF THE

FIBROUS RED ANTIMONIAL ORE.

THE *fibrous red antimonial ore* breaks at *Bräunſdorf*, in Saxony, in the mine *Neue Hoffnung Gottes*, upon a grey quarz: commonly accompanied by ſulphurated antimony (*grau Spieſsglanz-erz*) and ſometimes by cryſtals of the white ore of antimony (*weiſs-Spieſsglanz-erz*).

It occurs with a cherry-red, and modoré red colour, which is peculiar to it, and from which it has received the name of: *Kermes mineral.* Sometimes its ſurface exhibits variegated colours. It forms delicate capillary and needle-like cryſtals, which exiſt partly ſingle, partly faſciculated. Its luſtre is of the ſilky kind, and it is opake.

Its ſpecific gravity, (to aſcertain which ſome precaution is neceſſary, on account of the air-bubbles, accumulating on the incoherent aggregate of the tender cryſtals and to diſpel which is not eaſy), I found to be: 4.090.

A.

Upon one *hundred* grains of this ore was poured *muriatic acid*; and the retort being lodged in a ſand-bath, its neck was inſerted under a cylinder placed on the ſhelf of the pneumatic trough filled with hot water. As ſoon as the materials were acted upon by the heat, *ſulphurated hydrogen gas* was diſengaged. Towards the middle of the diſtillation this gas depoſited, not only in the neck of the retort but alſo in the water of the trough, ſome ſulphuret of antimony of a ſaturated orange-red colour, of which I was enabled to collect ſeveral grains. The obtained ſulphurated hydrogen gas, after deducting the common air of the retort, amounted to 37 cubic inches. *Antimoniated tartrite of pot-aſh* in ſolution, poured into a glaſs filled with this gas, immediately combined with it and produced ſulphuret of antimony of a full orange-red.

B.

a) One *hundred* grains of the ſame ore, in ſelected pure ſpecimens, were digeſted with *muriatic acid* in a long-necked matraſs. In this caſe, likewiſe, ſulphurated antimony ſettled on the neck of the veſſel; but appeared no more after the addition of a few drops of nitric acid. When the ſolution had been accompliſhed, there remained 1½ of a grey reſiduum, which, on gentle heating, deflagrated in the character of ſulphur.

b) The antimony contained in the ſolution, was precipitated, in the ſtate of a white oxyd, by diluting it with water, and the ſmall portion of the metal ſtill remaining in that fluid was afterwards entirely thrown down by means of pot-aſh. The oxyd thus procured, was rediſſolved in muriatic acid, the ſolution diluted with ſix times its quantity of water, and once more combined with ſuch a proportion of the ſame ſolvent, as was neceſſary in order to rediſſolve entirely that portion of the oxyd which the affuſed water had *precipitated*. After the dilute ſolution had, in

this

this manner, again been rendered clear, its ingredient timony was reproduced as *metallic antimony* by imme poliſhed iron in the liquor. It weighed, when colle edulcorated and dried, 67¼ grains.

C.

Sixty grains of the red antimonial ore were heated t redneſs, in a ſmall glaſs retort connected with the *pneumat mercurial* apparatus. A ſmall quantity of carbonic acid ga paſſed over into the receiver, amounting to about ¼ of a cubic inch, after ſubtracting the atmoſpheric air which before had filled the capacity of the retort. The greate part of the ore was found melted at the bottom, and converted into a finely ſtriated ſulphuret of antimony; while the whole interior ſurface of the retort and part of its neck was lined, and, as it were, glazed with a hyacinth-red, tranſparent vitreous oxyd of antimony; which, in ſome places, had coaleſced by fuſion into ſmall drops of various ſize. Of ſulphurated hydrogen gas not the leaſt ſign appeared.

This reſult from the experiment juſt mentioned perfectly agreed with my preconceived opinion, according to which I conſider the ſulphurated hydrogen, diſengaged on the ſolution of the red antimonial ore in the *humid way*, not as an *educt* but merely as a *product* which is generated only during that proceſs: as, in general, I know of no other direct demonſtration of the preſence of hydrogen in any other foſſil, of which the ſulphuric acid is the mineralizer, or of the actual exiſtence of any *metallic hydro-ſulphuret* formed by nature *.

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* Compare this with what has been ſaid, Eſſay LXXIV. F. pag. 26.

For this reaſon I imagine, that the red antimonial ore fers from the common ſulphuret of this metal (*grau Spieſ-nz-erz*) only in this circumſtance; that in the *firſt* the tal is combined with *oxygen*, whereas in the *ſecond* the tallic portion approaches more to the *reguline ſtate*.

According to *Thenard*, *one hundred* parts of antimony, in ſtate of a cheſnut-brown oxyd, that is, in the ſtate in ich it conſtitutes the metallic ingredient in the red annonial ore as well as in the artificial *kermes mineral*, ſaid to be combined with 16 parts of oxygen; which the $67\frac{1}{2}$ grains of antimony, reduced to the metallic te in the experiment B. *b*), gives 10.80 grains. Now, ice in this analyſis, beſides the oxyd of antimony and ſulhur, no other conſtituent part could be diſcovered, and nce the loſs, which is always unavoidable in ſuch proeſſes, may be fairly eſtimated at 2 *per cent.*; it follows, hat, after ſubtracting this loſs, the deficient 19.70 grains complete the whole weight of 100 grains employed B), re to be conſidered as the quantity of *ſulphur* contained the ore.

Therefore, the *fibrous red antimonial ore* from *Bräunſ-rf* conſiſts of:

Metallic Antimony	67. 50
Oxygen	10. 80
Sulphur	19. 70
	98.

XCIII.

CHEMICAL EXAMINATION OF THE *WHITE ORE OF ANTIMONY.*

THE *white ore of antimony* has been diſcovered ab years ago in the mines at *Przibram*, in Bohemia. forms white, reſplendent, ſtriated, oblong quadri tables of different ſizes. Such cryſtals of it as are ¼ of an i long, and ¼ of an inch broad, of which ſeveral inſta exiſt in my collection, are not frequently met with. a moderate preſſure they divide into ſmall ſpicula, re ling the needles of Aſbeſtus. Their matrix is a cryſt lized ſulphuret of lead *(galena)*, upon which they loosely imbedded.

The firſt information, both of the exiſtence of this fo as well as of its ſhewing the properties of antimony, been given by Mr. *Röſsler* *, of Prague. This intellige was afterwards confirmed by profeſſor *Hacquet*, of L berg †, who called it *Antimonium Spatoſum*, *album*, *ſ dens*; adding, he imagined to have obſerved ſome ind tions of muriatic acid, by the ſmell which it emitted w melting upon the charcoal.

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* *Crell's* Chemiſche Annalen. 1787. Vol. 1. pag. 334.

† *Ibid.* 1788. Vol. I. pag. 523.

At that time I directly ſubjected this foſſil to an exami-tion, which, however, the quantity I then had of it being o ſmall, I was obliged to confine merely to experiments ith the blow-pipe. It behaved as follows*: When ought upon the charcoal in entire lamellæ, it decrepitates ith a crackling noiſe, even before it is wholly penetrated the heat. On the contrary, when previouſly powdered, readily enters into fuſion the moment it is acted upon by e point of the flame; but at the ſame time it flies off in hite vapours, leaving ordinary white antimonial flowers ound the charcoal; and if the blaſt be continued, it is tirely diſſipated before any minute metallic globules can formed by reduction. But when combined with borax ub-borate of Soda), and treated in a like manner, ſmall tallic grains appear, which as ſpeedily eſcape in the form white vapours.

The ſame phenomena take place, on treating upon the arcoal the white oxyd of antimony, which is obtained by ecipitating, by means of water, the muriatic ſolution of is metal. In like manner is the ſame oxyd ſuſceptible a cryſtalline form, if it be precipitated with only a mode-te quantity of water, and the veſſel be ſet by, without gitation or ſtirring, in a quiet place.

From the circumſtance, that a notable portion of mu-iatic acid continues to adhere to the mentioned artificial xyd, it was likely, that a ſimilar deportment upon the harcoal would plead for the preſence of muriatic acid, ſpected by *Hacquet* in this foſſil. But this conjecture ceived no ſupport from the following examination.

Five and twenty grains of the white antimonial ore were mixed with 200 grains of carbonated pot-aſh in the higheſt degree of purity, and heated to redneſs in a platina-crucible. The maſs melted with a viſcid fuſion, and acquired an iſabella-yellow colour. On drenching it with water, the oxyd of antimony remained at the bottom imbued with the ſame colour. The decanted clear liquor was then a little ſuperſaturated with *nitric acid*; upon which the mixture became turbid and faintly white; yet it cleared again, and depoſited a ſmall quantity of a white oxyd of antimony. Which being ſeparated, liquid *nitrate of ſilver* was dropped into the clear fluid; but no change nor turbidneſs enſued. Hence the conjecture, which ſuppoſes *muriatic acid* to be a conſtituent part of the white ore of antimony, is deſtitute of foundation. This foſſil is a *pure oxyd of antimony*; which, as may be judged from its ſolubility in nitro-muriatic acid, is but imperfectly ſaturated with oxygen, and bears the greateſt reſemblance to the artificial ſilvery flowers of antimony.

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* *Crell*'s Chemiſche Annalen. 1789. Vol. I. pag. 9.

The white ore of antimony occurs alſo, though much ſeldomer, and only in ſingle very minute tables, on ſome old ſpecimens of the fibrous red oxyd of antimony from *Bräunſdorf*, in Saxony.

XCIV.

CHEMICAL EXAMINATION

OF

ARSENIATED OLIVE COPPER ORE.

(Olivenerz of Werner.)

THE *arſeniated ore of copper*, which in the ſyſtematic treatiſes on Mineralogy is diſtinguiſhed by the name of, *Olivenerz*, together with its different varieties, ſeems as yet ſtill excluſively to belong to the *Corniſh* copper-mines. When, in the year 1786, I gave the firſt account of its occurrence, and a preliminary notice of its conſtituent parts *; this laſt was founded only on its examination with the blow-pipe, as I then was not provided with a ſufficient quantity. It was only at a later period, that a larger ſtock enabled me to ſubject this ore to a more complete analyſis, and to repeat the ſame with ſeveral varieties of it, for the purpoſe of aſcertaining the nature and true proportion of its component principles. But ſince, with reſpect to all of them, the reſults of my experiments were conſtantly the ſame, with the exception of trifling differences in the proportions; I confine myſelf

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* Schriften der Geſellſchaft Naturforſchender Freunde in Berlin, Vol. vii. pag. 160.

merely to the analyſis of the *needle-ſhaped* variety *Carrarach* *.

I.

Needle-ſhaped Olive Copper-ore.

A.

a) Under the blow-pipe, upon charcoal, this ore detonates, emits a white arſenical ſmoke, and runs into ſmall reddiſh-grey globules, which, when again fluxed with borax, yield a pure regulus of copper.

b) A pure, maſſive ſpecimen of this ore, weighing [illegible] grains, was kept, in a porcelain crucible during 15 minutes, in a moderate red-heat. Its figure was not altered by the fire; but its dark olive-colour was changed into a bright graſs-green, inclining to that of the ſiſkin. Its weight was diminiſhed by 1¼ grain.

c) *Nitric acid* diſſolves it quietly in the cold, and the ſolution poſſeſſes an undefiled blue colour. By the addition of *nitrated ſilver*, the mixture is not in the leaſt rendered turbid. *Acetate of barytes* produces a precipitate which entirely diſappears upon dilution with water. The affuſion of diſſolved *acetate of lead*, forms with this ſolution a white precipitate, which upon the charcoal emits arſenical vapours, and is reduced to metallic lead, when combined with an exceſs of ammoniac, the precipitate falling down

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* The deſcription of its external characters, given by *Karſten*, may be ſeen in Vol. iii. of Neue Schriften der Geſellſch. Naturf. Freunde. 1801. pag. 294.

rſt, is directly re-diſſolved, no cloudineſs left behind,
the deep-blue colour is reſtored to the liquor.

) Alſo by the *acetic acid* this ore is gradually diſſolved.
n the evaporation of the ſolvent, a dark-green ſalt of a
ritical form remains behind.

B.

) One *hundred* grains of the acicular olive copper-ore,
ich had previouſly been freed, by means of elutriation,
m the admixed reddiſh iron-ochre, ſoon diſſolved in *nitric*
id, and without the application of heat. The ſolution,
ing accurately neutralized with carbonated pot-aſh, was
mbined with diſſolved *acetate of lead*, until all precipita-
n ceaſed. The obtained precipitate, when edulcorated
d dried in a raiſed temperature, weighed 133½ grains.

b) To be more convinced that this precipitate was an
eniated lead, I drenched it with water, and digeſted it
th half its weight of *ſulphuric acid*. The liquor ſepa-
ed by filtration, contained uncombined arſenic acid. I
tralized it with ſoda, and treated one part of it with a
ution of nitrated ſilver. This produced a copious pre-
itate of arſeniated ſilver, which poſſeſſed the brick-red
our peculiar to it, emitted arſenical vapours upon the
rcoal, and was readily reduced to pure ſilver. The
naining part of the ſolution, when mixed with liquid
rate of iron, afforded the common whitiſh precipitate of
eniated iron.

Now in order to aſcertain, by means of a comparative
eriment, the proportion of the acid of arſenic combined
th the 133½ grains of the mentioned precipitate *a*), I

diſſolved in water 100 grains of ſolid arſenical acid, and added to it a ſolution of *acetated lead* in ſmall portions ſo long as any precipitate would appear. The arſeniated lead, thus obtained, weighed 297 grains after edulcoration and drying in a warm place. Hence it followed, that the quantity of *concrete acid of arſenic*, combined with thoſe 133½ grains of the precipitate, which the acid of arſenic contained in the ore had produced, muſt be eſtimated at 45 grains.

And to be more aſſured that all the arſenical acid had been ſeparated from the nitric ſolution of the ore, I added a little more of acetated lead than would have been abſolutely requiſite. This was afterwards again precipitated as ſulphate of lead by adding ſulphated ſoda, and filtered off. To the ſolution thus freed from the laſt precipitate, I added uncombined ſulphuric acid, and precipitated the *copper*, now diſengaged from its mineralizing acid, by means of a poliſhed piece of iron, in the *metallic* ſtate. Thus I obtained of it 40½ grains.

But ſince in the compoſition of the olive copper-ore the copper is contained in the ſtate of an oxyd, it yet remained to diſcover the proportion of *oxygen*. To attain this end, I diſſolved 200 grains of pure copper in nitric acid, diluted the ſolution with a ſufficient quantity of water, and again precipitated the metal with a lixivium of *cauſtic* pot-aſh. The precipitate had a light-blue colour; but after the mixture had ſtood a couple of days in a moderately warm place, that blue colour was changed into a brown. When ſeparated by filtration, waſhed with a large quantity of water, and deſiccated in a low heat, this precipitate amounted to 269 grains. Upon ignition it weighed only 250 grains, and appeared in the form of a very ſubtle, fully-black powder.

Therefore, becauſe according to this experiment, copper acquires an increaſe of 25 *per cent.* of weight by combining with oxygen, it is obvious, that for the mentioned 40½ grains of metallic copper, we muſt put in the account 50. 62 grains of *oxyded copper.*

In conſequence of this decompoſition, one *hundred* parts of the olive copper-ore contain:

Oxyd of copper	50. 62
Acid of arſenic	45.
Water of cryſtallization . .	3. 50
	99. 12

II.

That *foliated olive copper ore* which is cryſtallized in beautiful *emerald-green*, *hexagonal tables* *, and breaks in the mine *Tincroft*, near *Redruth*, has till now been conſidered as a *muriated ore of copper*, and with this denomination introduced in ſome of the modern elementary books on Mineralogy †. This ſuppoſition, however, is erroneous. For, the nitric ſolution of this ore is miſcible with the nitric ſolution of ſilver, without any enſuing precipitation or turbidneſs; ſo that the total abſence of muriatic acid is fully proved. On the other hand, not only the crude ore itſelf, but alſo the precipitate obtained from its nitric ſolution, by means of acetated lead, when reduced with the blow-pipe upon charcoal, give out a vapour which, by its garlic-ſmell, ſufficiently ſhews to be arſenical.

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* Its external properties deſcribed by *Karſten.* See *loc. cit.* (A).

† See, for inſtance, *Eſtner*'s Mineralogy, Vol. iii. pag. 616.

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diſſolved in water 100 grains of ſolid
added to it a ſolution of *acetated lead* in
as any precipitate would appear. Th
obtained, weighed 297 grains after
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of *concrete acid of arſenic*, combin
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of cryſtallization.

Ore of Iron.

varieties of the *arſeniated*
another foſſil, which like-
arſenic as its mineralizer, but in
of iron inſtead of copper. That
in *Cornwall*, which firſt
this moment continued to be the
is ſeated as a very thin integu-
-ore, the matrix of which is a
by very *minute*, *graſs-green cubic*
and ſtrongly *ſplendent facets*.

contain iron, I have already made
given in the year 1786*. The

Entdeckungen aus der Naturkunde
pag. 261.

ſmal

ryſtals, that could then be had,
gh inveſtigation, rendered it im-
whether the copper which in this
iron, is an eſſential conſtituent part
ut accidentally originates from the vitre-
which is moſt intimately united with it,
ſeparable. That the latter is the caſe, I
at preſent the more convinced; as on having
tunity of making ſome ſmall experiments upon an
een variety of the Corniſh *arſeniated ore of iron*, in
ubic cryſtals, which has more recently been dug
he mines, I found it entirely free from copper.

XCV.

CHEMICAL EXAMINATION

OF THE

MURIATED ORE OF COPPER.

FROM the analyſis to which *Berthollet*[*] and *Prouſt*[†] ſubjected the *green ſand* from *Peru*, or the *Atacamit*, a foſſil brought to Europe by *Dombey*, that induſtrious collector of the natural treaſures of South-America, it reſulted that alſo the *muriatic acid* belongs to the number of thoſe ſubſtances, by which nature mineralizes copper.

Subſequently to that diſcovery, another green copper-ore, occurring maſſive, and ſaid to be found at *los Remolinos*, in *Chili*, was introduced into public notice. This, likewiſe, has been examined by *Prouſt*, at Madrid, and found to be a muriated copper-ore[‡].

By a portion which I received of this yet ſcarce foſſil[§], I was enabled to undertake its decompoſition, and to compare the reſults with thoſe of the analyſis made by *Prouſt*.

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[*] Memoirs de l'Acad. des Sciences, Paris, 1786. p. 153.

[†] Annales de Chemie. Tom. xxxii. p. 26. ſeq.

[‡] Ibid.

[§] For the external characters of this ore, conſult *Karſten* in the 3d vol. of the Neuen Schriften d. g. nat. Fr. 1801. p. 301.

In theſe experiments I firſt waſhed the mineral; becauſe, notwithſtanding its cryſtaline texture, it is in part ſtrongly contaminated with a ferruginous ochre. After this is removed, by elutriating the powdered ore, the laſt exhibits a more beautiful and darker green colour.

A.

a) Heated upon charcoal, before the blow-pipe, it imparts to the flame a very lively blue and green colour; the muriatic acid is ſoon diſſipated, and a metallic button of pure copper remains.

b) If heated in a crucible, the green colour of the foſſil is readily changed into black; but on expoſure to air its ſurface is again gradually rendered greeniſh. Its loſs of weight at a moderate heat is from 6 to 9 in one hundred. On urging the fire to the commencement of glowing, white vapours ariſe, which cauſe a diminution of weight from 15 to 18 *per cent.*

c) A portion of the ore finely pulverized was boiled with water. The decoction had no colour, and afforded, with a ſolution of nitrated ſilver, only a ſmall quantity of a white precipitate, which blackened in the day-light.

It reſults from this, that the muriatic acid is not contained in this ore in ſuch a quantity, as would be neceſſary to produce a compound ſoluble in water.

B.

a) One *hundred* grains of the elutriated mineral diſſolved readily and quietly in the *nitric acid* affuſed in the cold. The ſolution poſſeſſed a pure blue colour, and depoſited a little of a brown iron-ochre, which, ſeparated by filtering, weighed 1½ grains. It was then diluted with water, and treated with a nitric ſolution of ſilver. The precipitated muriate of ſilver, when edulcorated, dried and melted at a moderate degree of heat, in a ſilver pan, weighed 64½ grains.

One hundred parts of metallic ſilver yield by ſuch combination 133 parts of muriated ſilver. But as this metal, to be rendered ſoluble in acids, takes up 12½ *per cent.* of oxygen, theſe muſt be ſubtracted; ſo that of this increaſe of weight by 33 parts, there remain 20½ for the muriatic acid.

Theſe principles being laid down, the mentioned 64½ grains of muriated ſilver will fix the proportion of the *muriatic acid*, contained in 100 parts of the ore, very nearly to 10 grains.

b) That I might be ſure of having completely ſeparated the muriatic acid from the nitric ſolution of this copper-ore, I added the nitrated ſilver in a ſmall degree of exceſs: and this retent of ſilver I afterwards threw down with muriatic acid and filtered it off. Which done, the *copper* was precipitated in the *metallic ſtate*, by means of a piece of poliſhed iron immerſed in the ſolution. It amounted to 57½ grains when collected and carefully dried.

The copper, however, is contained in the ore as an *oxyd.* In this ſtate its weight is increaſed 25 *per cent.* by the oxygen; which, for thoſe 57. 50 grains of *metallic copper,* juſt now mentioned, gives by calculation 14. 38 grains.

Now, ſince what is yet deficient from the firſt weight of the ore employed is to be conſidered for the greateſt part as its water of cryſtallization, and ſince thoſe 1½ grains of ferruginous ochre *a*) do not belong to the compoſition of the ore; the conſtituent parts of the *muriated ore of copper* may be ſaid to be in the *hundred* as follows:

Oxyd of copper	73.
Muriatic acid	10. 1
Water of cryſtallization . . .	16. 9
	100

In the analyſis of this copper ore, publiſhed by *Prouſt,* the proportion of its conſtituent parts has been ſtated thus:

Oxyd of copper, 76$\frac{28}{47}$; *muriatic acid,* 10$\frac{30}{47}$; *water* 12$\frac{16}{47}$. —This, in the eſſential points, nearly agrees with the preceding; and on this account both theſe analyſes may reciprocally ſerve as a confirmation to each other.

* * *

Concerning the *green ſand* from *Peru,* mentioned at the beginning of this Eſſay, it is to be conſidered merely as a *variety* of the muriated copper-ore; for, it not only contains the very ſame conſtituent parts, but likewiſe almoſt in equal proportions, which *Prouſt* has given as hereunder:

Oxyd of copper, $70\frac{40}{83}$; *muriatic acid*, $11\frac{37}{83}$; *water*, $18\frac{6}{83}$.

XCVI.

CHEMICAL EXAMINATION

OF THE

PHOSPHATED ORE OF COPPER.

HE diſcovery, that the *phoſphoric acid* or its baſe is a nciple which does not belong excluſively to the vege- le and animal kingdoms, but is alſo the property of the neral kingdom of nature, has conſiderably enlarged our neralogico-chemical knowledge. The combinations of s acid, which ſince that diſcovery have become known; , *Apatite*, with its varieties; ſome ſpecies of *lead ores*; *Lowland Meadow-ore*, with its varieties; and the blue *artial-earth*.

Theſe mineral combinations with the phoſphoric acid are w joined by the foſſil, which furniſhed the ſubject of this quiry, and proves to be a new ſpecies of copper-ores.

It is found in the *Firneberg*, not far from *Rheinbreidbach*, on the Rhine; where, on account of its green colour d ſtriated texture, it has been miſtaken for a ſpecies of alachites.

Of this green copper-ore and its varieties, Mr. *Noſe*[*] has long ago given information, calling it, Malachite. To this, as well as to *Karſten's*[†] paper, concerning its external properties, I refer the reader for the ſake of brevity.

Upon the charcoal, under the blow-pipe, it fuſes into a dark-brown ſcoriaceous maſs, which indeed at firſt aſſumes a ſpherical figure, but is ſoon more ſtrongly attracted by the coal, and diffuſes ſpreading upon it. After cooling, its ſurface ſhews a dull metallic ſplendour of a reddiſh-grey tinge.

I tried to decompoſe it by the following method.

a) Becauſe this ore is very much intermixed with its quarzoſe matrix, I pulverized a portion of it, previouſly freed as much as poſſible from the ſtony matter, and aſcertained the weight of quarz ſtill united with it, by ſolution in *nitric acid.* The quarz amounted to 16 parts in 100 of the purified ore.

On this conſideration, I weighed 116 grains of the powdered ore, and poured *nitric* acid upon it. The mixture became of itſelf moderately warm. When the ſolution, aſſiſted by a little heat, was thoroughly brought about, and by means of filtration freed from the undiſſolved quarzy matrix, it ſhewed by its pure ſky-blue colour, that it contained no iron.

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[*] *Crell's* Chemiſche Annalen. 1788. Numb. iv. p. 306.

[†] Neue Schriften d. Geſ. Naturf. Freunde. Vol. iii. p. 304.

b) After

ıfter the ſmall portion of the predominant acid had been ɛed with pot-aſh, I added to the ſolution diſſolved *of lead*, until no farther precipitation took place. ɪrecipitate was at firſt drenched for a while with weak acid, then elixiviated with water, and at laſt per- dried in a low heat. It weighed 138 grains.

ıt this precipitate was a combination of lead with ıoric acid, of this I had myſelf aſſured by a previous ment, made with another portion of the ſame foſſil. ibited the phenomenon, which is peculiar to phoſ- lead; namely, that under the blow-pipe it runs into l, which in the very moment of fixation, rapidly s a garnet-like form with ſhining ſurfaces.

ɔn another portion of that precipitate, half its weight *ɔhuric acid*, ſufficiently weakened with water, was l and digeſted with it. The clear fluid, which had iltered off from the generated ſulphate of lead, and ned free phoſphoric acid, was firſt half ſaturated with and upon this perfectly neutralized with ammoniac. yſtalization, it yielded microcoſmic ſalt, or phoſphate ı and ammoniac.

In order to diſcover the proportion of the phoſphoric ɔmbined with thoſe 138 grains of the precipitate men- before, I proceeded to the following experiment.

urned pure phoſphorus under a large glaſs-bell, diſ- the obtained dry phoſphoric acid in water, paſſed it ;h the filter, and reduced it by evaporation, in a eat, to a ſmaller volume. When towards the end s proceſs flames of phoſphorated hydrogen gas appeared, I added nitric acid by drops till no longer any n vapours were diſengaged.

Of this perfectly oxygenated unctuous liquid phoſphoric acid, I diluted 100 grains with water, and neutralized the liquor with finely powdered white marble; of which 324 grains were employed. The mixture was evaporated to dryneſs, and the dry maſs kept in a moderare red heat for half an hour. This ignited phoſphate of lime weighed 256½ grains. In the 324 grains of marble employed in this experiment, the portion of *lime*, or pure calcareous earth, amounts to 178. 20 grains, which if ſubtracted from the above 256. 50 grains, determine the quantity of the phoſphoric acid ingredient in that calcareous phoſphate to be 78. 30 grains.

From theſe data, taken together, it now was rendered evident, that in thoſe 138 grains of phoſphated lead, which have been produced by the combination of lead with the phoſphoric acid, conſtituting a component principle of the portion of the ore examined,—the *concrete phoſphoric acid* amounts to 30. 95 grains.

d) The remaining part of the ſolution, which yet contained the cupreous part of the ore, was firſt treated with *ſulphate of ſoda*, to ſeparate the ſmall portion of lead it ſtill held diſſolved from a ſlight exceſs of acetated lead added in the proceſs *b*). Which done, it was mixed with a little of uncombined *ſulphuric acid*, and a piece of poliſhed iron put into it to precipitate the *copper*, which I found to weigh 54. 50 grains. But as this metal is contained in the ore in an *oxyded ſtate*, which requires 25 *per cent.* of oxygen; there muſt 68. 13 grains be reckoned for the *oxyd of copper*.

One *hundred* grains of this *phoſphated ore of copper*, there- , conſiſt of,

Oxyd of copper	. . . . . .	68. 13
Phoſphoric acid	. . . . . .	30. 95
		99. 08

XCVII.

CHEMICAL EXAMINATION

OF

KRYOLITE.

KRYOLITE is one of the moſt remarkable foſſils of modern diſcovery in the mineralogical department of natural ſcience. Its native country is *Greenland*, whence it was brought, ſome years paſt, to *Copenhagen*, in only a few ſpecimens. Profeſſor *Abildgaard*, to whom we are indebted for ſeveral enlargements of mineralogical chemiſtry, has ſubjected alſo this foſſil to analyſis, and diſcovered that it contains *fluoric acid* and *alumine* as conſtituent parts certainly an unexpected combination, of which no inſtance has before occurred in nature. Mr. *Andrada*, who became acquainted with this new foſſil at Copenhagen, has given of it a mineralogical deſcription in his *ſhort notice concerning ſome new foſſils from the North* *: where, beſides the alumine and fluoric acid, he mentions a ſlight quantity of potaſh as one of its conſtituent parts. Among the ſyſtematic authors, *Karſten* † was the firſt who noticed it.

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* This notice tranſlated into Engliſh may be ſeen in *Nicholſon's* Journal for Natural Philoſophy, Chemiſtry, &c. Vol. v. 4to. page 193.—Tranſl.

† *Karſten's* Mineralogiſche Tabellen. Berlin 1800. pag. 28. and *appendix* to the ſame work, pag. 73.

Although Kryolite ſtill belongs to the ſcarcer foſſils, yet this circumſtance has not prevented Mr. *Abildgaard* from ſharing between him and me the ſmall portion he poſſeſſed of it. It was thus, by his kindneſs, that I was enabled to analyſe it.

External Characters of Kryolite.

The colour of Kryolite is a *pale greyiſh-white.* Its exterior ſhape is at preſent not yet well known. *Main-fracture* reſplendent, *croſs-fracture* little reſplendent; both of the *glaſſy-luſtre.* Again; *fracture* foliated, in *two oppoſite directions, decuſſating each other at right angles:* in other directions *uneven.* It exhibits *ſtraight lined detached lamellæ*; burſts in *cubical fragments.* It is *tranſparent*, *ſoft*, *pretty mild*, *eaſily burſting*, and not very heavy.

Its ſpecific gravity, according to *d'Andrada*, 2.9698; according to *Haüy*, 2.949.

Before the blow-pipe, upon charcoal, Kryolite becomes rounded in the form of a milk-white, dull, opake globule; but on continued ignition its fuſibility decreaſes, and the foſſil aſſumes the form of a hard-baked earth. Hence it appears, that the name *Kryolite* has been given to this foſſil, not ſo much becauſe it melts before the blow-pipe like ice; but probably, rather from ſome reſemblance which it bears in its external appearance to opake ice.

Analyſis of Kryolite.

A.

1) *Sixty grains* of Kryolite were pulverized, mixed in a platina-crucible with 120 grains of ſulphuric acid, and

[illegible] glaſs, which had a [illegible] [illegible]. Very fine [illegible] [illegible] hours, the [illegible] [illegible]. The maſs was [illegible] [illegible] to dryneſs. [illegible] [illegible], and again been [illegible] [illegible] earth on the [illegible]

[illegible] yielded, as before, [illegible] [illegible]. But as a portion [illegible] [illegible] it, I ſeparated [illegible] [illegible] of ſpirit of wine, which being [illegible] [illegible] cauſtic [illegible], let fall another [illegible] [illegible] earth. This, [illegible] with that before [illegible] [illegible]

3) The [illegible], that has been waſhed [illegible] [illegible], was diſſolved in water, and left to [illegible] [illegible]. It yielded three regular clear cryſt [illegible] of weight, which, on cloſer examinati [illegible] to be *ſulphate of ſoda*. The remainder o [illegible] in the open air to an irregular, ſm [illegible] maſs, which, when diſſolved in water, with the above-mentioned ſolution of earth i acid, then precipitated with carbonate of amm filtered. The precipitated earth being edulcorate diſſolved in the lixivium of *cauſtic ſoda*, poured up pot-aſh. After this lixivium had been again with ſulphuric acid, I precipitated the earth, w in ſolution, by means of carbonated pot-aſh. diſſolved in ſulphuric acid, and combined with a pro tion of pot-aſh, the whole of the ſolution yielded *ſulphate of alumine.*

4) The fluid from which the aluminous ear thrown down by carbonate of ammoniac, was

tralized with acetic acid, and then precipitated by *acetate of barytes*. The filtered ſolution was evaporated to a dry ſalt, and this laſt heated to redneſs in a platina-crucible. The melted ſaline maſs rendered ſomewhat blackiſh from the adhering coal, again diſſolved in water, freed by filtration from the coaly particles, and evaporated, yielded 26 grains of dry *carbonated ſoda*. This laſt, ſaturated with nitric acid, ſhooted into regular rhombic cryſtals of nitrated ſoda.

Thus have I, beſides the two conſtituent parts of Kryolite mentioned by *Abildgaard*, unexpectedly found *ſoda* as its third eſſential conſtituent part. My ſatisfaction occaſioned by this diſcovery was heightened by the circumſtance, that Kryolite is the firſt inſtance that came to my knowledge of a ſolid ſtony foſſil, in which ſoda is contained in the capacity of a conſtituent part. Dr. *Kennedy* has, indeed, informed the Public of his having diſcovered ſoda in the lavas of mount Ætna, and in the baſalts; but till now I have not yet been convinced of it by my own experience*.

Mr. *Vauquelin*, who likewiſe has examined Kryolite, ſuſpects that, perhaps, during the decompoſition effected by ſulphuric acid, part of the aluminous ingredient is carried off along with the fluoric acid†. In fact it would hardly be poſſible to explain, in what manner 28 *per cent.* of alumine, the quantity found by *Vauquelin* in that foſſil, ſhould be capable of fixing ſuch a quantity of fluoric acid as is neceſſary to make the concrete neutral compound, which is generated by this combination, amount to 100 grains.—However, this difficulty is removed by the preſence of ſoda diſcovered in the foſſil.

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* It will be ſeen in *Eſſay* CI. of this work, that ſubſequently to the time alluded to I have analyſed the *Baſalt*, from *Bohemia*, and likewiſe found *ſoda* among its conſtituent parts.

† *Journal de Phyſique*. Frimaire. An. 8.

B.

For the purpoſe of determining the proportions of the conſtituent parts of Kryolite, I repeated its analyſis in the manner I ſhall now deſcribe.

1) *Hundred* grains of triturated Kryolite, to expel entirely the fluoric acid, were inſpiſſated to dryneſs in a platina-crucible with 300 grains of concentrated *ſulphuric acid*. The mixture boiled at firſt, emitting fluoric acid vapours and numerous air-bubbles, in the manner as a concentrated ſolution of ſugar is carrying on. The reſidual maſs, previouſly drenched with water, congealed on evaporation to a ſoft, granular ſaline maſs, which readily liquefied in a little water.

2) *Cauſtic* ammoniac precipitated from the clear ſolution the *aluminous earth* of 46 grains when edulcorated and dried, but of 24 when ignited. The ſolution of this earth, in dilute ſulphuric acid, with the aſſiſtance of heat, and combined with a juſt proportion of pot-aſh, ſhooted wholly upon evaporation into regular cryſtals of alum.

3) The fluid, from which the alumine had been precipitated by the ammoniac, was neutralized with *acetic acid*, then combined with *acetated barytes*, and filtered to ſeparate the barytic ſulphate. The clear fluid was now wholly evaporated, its dry reſiduum ignited in a platina crucible, re-diſſolved, and after being rendered free, by filtration, from the few adhering coaly particles, a ſecond time evaporated to perfect dryneſs. It thus af-

forded 62½ grains of dry carbonate of ſoda, equal to 36 grains of *pure ſoda.* This ſaturated with acetic acid, cryſtallized all to acetate of ſoda.

If now from the quantity of the foſſil employed be ſubtracted the weight of alumine and ſoda obtained, the remainder will give the weight of the ingredient fluoric acid, including, perhaps, the water of cryſtallization. One *hundred* parts of *Kryolite*, therefore, conſiſt of,

Soda	36
Alumine	24
Fluoric acid, including the water	40
	100

XCVIII.

CHEMICAL EXAMINATION

OF

BERYL.

THE diſcovery of a new diſtinct earth, made by *Vauquelin*, and which, from the ſweet taſte it imparts to its neutral combinations, he calls *Glucine* (*ſweet earth*), was too important for me to refrain from endeavouring to procure a portion of it, in order to become acquainted with its chemical properties, by experiments of my own. Yet, though upon the whole the reſults of my inquiries agree with thoſe of *Vauquelin*, I deem the publication of my analyſis not quite ſuperfluous: principally, becauſe thoſe chemical decompoſitions, the object of which is the diſcovery of a new, or at preſent unknown link in the chain of ſubſtances formed by nature, will, by the agreement of the reſults from repeated experiments, ſo much the ſooner receive the wiſhed for confirmation.

a) One *hundred* grains of the *bluiſh-green beryl* from *Siberia* were moſt finely pulverized; they acquired 2 grains additional weight abraded from the *flint-mortar*. I mixed the powder with a ſolution of 250 grains of *cauſtic ſoda*, evaporated the fluid in a *ſilver crucible*, and expoſed the dry maſs for one hour to a moderate red-heat. The refrige-

rated

ated maſs was white, with a ſhade of green. On diffuſion in water, and ſuperſaturation with *muriatic acid*, all of it diſſolved clearly. This mixture was evaporated in a ſand-bath to a moderately dry maſs; which exhibited a yellow colour. When rediſſolved in water and filtered, *ſiliceous earth* was left behind to the amount of 68¼ grains after ſtrong ignition: of which, on ſubtracting the 2 grains worn off from the mortar, 66¼ grains remain.

b) The muriatic ſolution was precipitated by means of carbonated ſoda; the waſhed precipitate was diſſolved in *ſulphuric acid* added in a ſmall exceſs; its ſolution was firſt a little concentrated by heat, and then by degrees combined with diſſolved carbonate of pot-aſh, ſo long as the earth, thrown down by the alkali, would rediſſolve by ſtirring. As the alum generated in this proceſs, had not water enough to continue in the diſſolved ſtate; it neceſſarily depoſited in minute cryſtals, the quantity of which I found increaſed after the veſſel had ſtood one night in a diſh holding cold water. The ſupernatant fluid when decanted and mixed with the waſhings of the cryſtalline grains of the ſulphate of alumine, or *flower of alum*, as it is called in the alum-works, was combined with a concentrated ſolution of carbonate of ammoniac; added in *eight* times that quantity which would have been neceſſary, merely to produce a precipitation. The quantity of earth which at the beginning was precipitated, viſibly diminiſhed. After this mixture had ſtood 24 hours in a ſtoppered veſſel, during which it was frequently agitated, I ſeparated by filtering the ſupernatant clear liquor from the undiſſolved reſiduum, and kept it boiling in a ſand-heat, until the whole of the earth which it held in ſolution had fallen down; upon which it was collected, edulcorated and dried. Its weight while in the carbonated ſtate amounted to 27½ grains; after ignition, or in the ſtate of *pure glucine* *, it weighed 14¼ grains. It had all the characteriſtic marks and properties, deſcribed by *Vauquelin*. Diſſolved in ſulphuric acid and cryſtallized, it ſhooted into cryſtals which ſeemed to be double quadrilateral pyramids (joined baſe to baſe) with truncated angles and edges.

c) That portion of earth which eſcaped the ſolution by carbonated ammoniac, I diſſolved in ſulphuric acid, mixed the lixivium with the aqueous ſolution of the above mentioned granularly cryſtallized alum, and poured upon the mixture an over-proportion of liquid *cauſtic* ſoda. The precipitate diſappeared as ſoon as formed, leaving ſome iron in light-brown flocks; which collected and ignited weighed 0.80 grains. But this when again diſſolved in muriatic acid, left 0.20 grains of *ſiliceous earth*: ſo that 0.60 grains are the weight of *oxyded iron* contained in this foſſil.

d) The alkaline ſolution *c*) was neutralized with muriatic acid, and its alumine precipitated by carbonate of ſoda. It weighed 17 grains in the dry and ignited ſtate. I rediſſolved it in ſulphuric acid, and promoted the lye to cryſtalization by adding of pot-aſh and evaporation. When the greateſt part of it had ſhooted in regular cryſtals, I affuſed upon the remainder a large quantity of liquid carbonate of ammoniac. After 24 hours I ſeparated the ammoniacal fluid from the aluminous earth by filtration, and reduced it to half its volume by boiling in a matraſs. A little of *glucine* depoſited, weighing ¼ of a grain, when ignited. This deducted from the 17 grains of *alumine* determines the weight of this laſt at 16¼ grains.

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* However well choſen the name *glucine* appeared at firſt, it would in my opinion be better to ſubſtitute to it that of *beryllina*, which name would more diſtinguiſh and characteriſe it; ſince in the *yttria* we are now poſſeſſed of another earth, which likewiſe gives a ſweet taſte to the neutral ſalts formed by it.

Therefore, this pale-bluiſh-green variety of the Siberian beryl has been decompoſed, into:

Silex	a)	66. 25	66. 45
	c)	0. 20	
Alumine	d)		16. 25
Glucine	b)	14. 75	15. 50
	d)	0. 75	
Oxyd of iron	c)		0. 60
			98. 80

* * *

Although I have performed the preceding analyſis of beryl, ſoon after the intelligence received of Mr. *Vauquelin*'s diſcovery of *glucine*, contained in that foſſil; yet it is only now that I publiſh it: ſo that I might ſuppoſe its contents were unknown before. Hence I do not know upon what ground Dr. *Schaub*, on giving an account of his very ſkilful analyſis of beryl *), could ſay: that I contradict the reſults of the analyſis made by *Vauquelin.*

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* *Crell's* Chemiſche Annalen. 1801. Numb. 3. p. 174 *ſeq.*

XCIX.

CHEMICAL EXAMINATION OF *EMERALD.*

IT is owing to the great reſemblance which *glucine* bears to alumine, in ſeveral of its chemical properties and relations, that it has not been diſcovered at an earlier period in thoſe two ſpecies of ſtones, the *emerald* and *beryl*, of both of which it is a remarkable co-conſtituent part, but, on the contrary, continued unknown in its combination with alumine: not only in thoſe earlier analyſes of emerald by *Bergmann*, *Achard*, *Bindheim*, *Heyer*, *Hermann*, *Lowitz*, but alſo to *Vauquelin* and to myſelf in our firſt experiments we made upon that foſſil. But no ſooner had *Vauquelin* diſcovered that new earth in the beryl, than the ſagacious *Haüy* was, by the oryctognoſtic affinity of beryl with emerald, led to ſuſpect ſimilar conſtituent parts in the latter. This new point of view, indicated by *Haüy*, induced *Vauquelin* to ſubject the emerald to a ſecond analyſis; and the reſult happily anſwered the expectation. As long as the exiſtence of any principle in nature is unknown, it may often lie within the reach of the chemiſt, and yet elude his moſt ſerious attention; while, on the contrary, after the exiſtence of ſuch a principle is proved, we cannot help wondering, that it has ſo long continued to be unknown.

or the following decompoſition I could employ no er emerald, but a ſpecimen of a very pale-green co- r.

I.

a) One *hundred* grains of *light-green emerald* were levi- ed in a flint-mortar, by which their weight increaſed grains. The powder of the ſtone was mixed with a ution of 250 grains of *cauſtic* ſoda, and inſpiſſated in a *ver-crucible*; upon which the dry maſs was moderately nited during 30 minutes.

b) When this maſs had cooled, it appeared white, and ould not eaſily be ſoftened in water. It was ſaturated exceſs with *muriatic acid*, which effected a thorough ſolu- on of a pale ſtraw-yellow colour. This being evaporated a moderate dryneſs, and afreſh diffuſed in water, was rown upon the filtrum in order to collect the diſengaged *ceous earth*, which waſhed, dried and ignited, weighed grains after deducting the 2½ grains it received from the ortar.

c) The muriatic ſolution was combined to ſuperſaturation ith diſſolved *cauſtic ſoda* and boiled. The precipitate was on again taken up by the fluid, excepting ſome looſe, rk aſh-grey flocks, which upon drying and ignition ex- bited a light-brown reſidue weighing 2½ grains. As the tering paper, upon which this reſidue has been collected, as coloured browniſh, it was extracted with a little eak muriatic acid, and the ſolution treated with Pruſſian ali, which produced a blue precipitate of iron.

d) Upon thoſe 2½ grains of the browniſh reſiduum nitric acid was poured and again driven off by heat; after which a *cauſtic lixivium* was affuſed. This took up but a little, and the reſiduum, again waſhed and ignited, loſt only $\frac{3}{10}$ of a grain. The alkaline fluid was neutralized with *nitric acid*, and one half of it combined with *acetated lead*, the other half with *nitrate of ſilver*. By the lead a lemon-yellow, and by the ſilver a brown-red precipitate was obtained. Thus the portion of *Chrome* ingredient in emerald was ſeparated, and obtained ſingly.

e) The brown reſidue of *d)* was diſſolved in *muriatic acid*; but the ſolution, acted on by a low heat, ſoon coagulated into a jelly-like ſubſtance, owing to the *ſiliceous earth* which ſeparated and upon ignition weighed grain. The fluid, freed from this, was then treated with a ſolution of ſuccinate of ſoda. The precipitate, obtained by this means, when edulcorated and dried gave 1 grain of *oxyded iron*.

f) As to the alkaline ſolution *c)*, I mixed it with the remaining fluid of *e)*, ſuperſaturated the mixture with *muriatic acid*, and precipitated it in an ebullient heat with carbonated ſoda. The precipitate here obtained, I diſſolved in ſulphuric acid, and after having combined it with acetated pot-aſh forwarded it to cryſtallization. The firſt ſhootings yielded ſulphate of alumine in pure cryſtals. But on ſubſequent evaporation ſulphate of lime appeared in delicate needles; which in the ignited ſtate weighed $\frac{3}{4}$ of a grain, equivalent to $\frac{1}{4}$ gr. of *pure calcareous earth*. What ſtill remained of the fluid had now a thick oily conſiſtence. Diluted with a little water and expoſed to ſpontaneous cryſtallization, it afforded cryſtals: but they had not the regular form of alum.

g) This ill-ſhaped ſaline maſs together with the ſulphated alumine already obtained, was diſſolved in water, and a large quantity of liquid carbonate of ammoniac affuſed: upon which I ſtoppered the veſſel. After it had ſtood 24 hours, I ſeparated the remaining earth by means of the filter, diſſolved this laſt again in ſulphuric acid, and laſtly extracted it by adding a great over-proportion of carbonated ammoniac, in the manner ſtated before [*]. When the earth had again been ſeparated, it was a ſecond time ſubjected to the ſame treatment: after which nothing more was taken up by the ammoniac.

h) The *aluminous earth*, was now heated to redneſs; it then amounted to 15¾ grains. On being diſſolved in ſulphuric acid, as well as combined with a little pot-aſh, and evaporated to cryſtallize, it yielded pure ſulphate of alumine.

i) From the ammoniacal fluid, which had been collected from thoſe reiterated extractions, the ſuperabundant alkali was diſtilled off in a capacious retort, until the quantity of the white earth, which parted from the fluid in thick flocks, no longer increaſed. This earth, when elixiviated and dried weighed 23½ grains. After ignition its weight proved to be 12½ grains.

When rediſſolved in *ſulphuric acid* and left to ſpontaneous cryſtallization, it ſhooted by degrees into *oblique, quadrilateral double pyramids*, with truncated edges and corners. The ſaccharine taſte of theſe cryſtals, in conjunction with their other properties, ſhewed that the baſe of this ſalt was *glucine*, the new earth diſcovered by *Vauquelin* in the Beryl.

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[*] The author ſeems to allude to Eſſay XCVIII. *b)* page 173.

Hence this decompoſed *Emerald* has yielded as its conſtituent parts:

Silex . . .	*b*)	68.	. . 68. 50
	e)	0. 50	
Alumine . . .	*b*)	. . . .	15. 75
Glucine . . .	*i*)	. . . .	12. 50
Lime . . .	*f*)	. . . .	0. 25
Oxyd of iron .	*e*)	. . . .	1.
Oxyd of chrome .	*d*)	. . . .	0. 30
			98. 30

II.

The proportions of the conſtituent parts of emerald, ſtated by Mr. *Vauquelin*, are:

Silex	64. 60
Alumine	14.
Glucine	13.
Lime	2. 56
Oxyd of chrome	3. 50

There ſeems to be no doubt, but Mr. *Vauquelin* had opportunity of experimenting on emeralds of a more ſaturate green colour; having educed a much greater quantity of chromic oxyd than I could obtain. But, if *Vauquelin* has found no iron, and for this reaſon will not admit it as a conſtituent part of emerald, my experience proves the contrary. For, beſides that I have always obtained oxyded iron from emeralds, on repeated decompoſitions of this foſſil in the way juſt now explained, I have found even the mere digeſtion with acids ſufficient for extracting its ferrugineous portion.

One *hundred* grains of pulverized emerald were expoſed to a continued digeſtion of *muriatic acid*, to which after ſome time a little of the nitric was added. The filtered pale, ſtraw-yellow coloured fluid was ſuperſaturated with *cauſtic* ammoniac. Oxyd of iron ſeparated in looſe, brown flocks, weighing 0.80 grains*. To diſcover whether any portion of chrome was mixed with it, I drenched it with nitric acid, evaporated the mixture to dryneſs, digeſted it with a cauſtic alkaline lye, and ſubſequently to its dilution ſeparated at laſt the oxyded iron, by means of the filter. The alkaline fluid was colourleſs. It was neutralized with nitric acid, and, divided into three portions, treated with ſolutions of nitrated ſilver, nitrated mercury, and nitrated lead. But in no inſtance either any change or any turbidneſs was produced. When after this I proceeded to the farther decompoſition of the emerald thus extracted, in order to obtain its ingredient glucine, it yielded, beſides the chromic portion, another ſlight quantity of oxyd of iron.

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* *Quære:* Has the *muriatic acid* uſed in this proceſs been itſelf entirely *free from iron?* As it is well known to be a difficult matter to obtain it in that ſtate.—One ſhould ſuppoſe the celebrated author has not overlooked this circumſtance.—Perhaps there exiſted an accidental difference in the ſpecimens examined by *Klaproth* and *Vauquelin*. This remark might ſerve as a general rule: otherwiſe there will be no end of diſputes, no certainty obtained. But if ſuch accidental differences are attended to and noted down, it will be eaſy to underſtand why different analyſes of the ſame ſubſtance by different perſons, though made with equal ſkill and equal exactneſs, may give different reſults, and yet be all of them in ſome manner correct.—Tranſl.

C.

CHEMICAL EXAMINATION OF *KLINGSTONE*[*][†].

FIRST SECTION.

ALTHOUGH by the active induſtry of Naturaliſts, who have impoſed upon themſelves the taſk of the chemical inveſtigation of mineral ſubſtances, the limits of our knowledge in this branch of natural ſcience have of late been uncommonly enlarged; yet it ſtill preſents a great number of chaſms, more eſpecially with reſpect to the common ſpecies of ſtones and rocks: notwithſtanding that a chemical knowledge of them, whether with regard to ſcience in general, or with regard to the particular utility and ad-

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[*] Read in the Royal Academy of Sciences at Berlin, 25th June, 1801.

[†] The tranſlator has not met with any appellation adopted for it by Engliſh mineralogiſts; he, therefore, thought it proper to preſerve the German: as *blende*, *quarz*, *wacke*, &c. are uſed. The word *kling-ſtein* imports a ſounding ſtone. That the preſent foſſil is called ſo from its property of giving a ſound on being ſtruck we are told by the author himſelf. Thoſe who are fond of a terminology derived from the Greek, may call it *Echolite* or echodolite, from ἦχος *ſound*, or ἠχώδης *ſounding* or *ſonorous*, and λίθος ſtone.—Tranſl.

vantage

tage which it may be capable of affording, cannot but is equally important and valuable, as the examination he more coſtly and ſcarcer foſſils.

The following chemical decompoſition of the *Kling-ſtone*, ch conſtitutes the principal maſs of the *ſchiſtoſe porphyry* rphyr-ſchieſer) or better of the *Kling-ſtone porphyry*, l ſhew that alſo the examination of common and daily urring ſtones may lead to unexpected and intereſting overies.

The ſchiſtoſe-porphyry is a ſpecies of ſtone, which, not- hſtanding that it ſo frequently occurs and even in maſſes ning entire mountains and rocks, yet was doomed by a ular fate long to continue to be diſregarded, unknown confounded with other ſtones.

The firſt denomination, under which it has been ad- ted in oryctognoſtic treatiſes, is that of *Hornſchieſer* *rn-ſlate*). However, this name does not excluſively ng to it; for which reaſon, various authors denote by ſame name ſeveral different ſpecies of ſtones. This man denomination ſeems to have been occaſioned by latin *corneus fiſſilis* of *Wallerius*; though it is obvious n the deſcription which he has given of his corneus is, that he did not mean to ſignify by that name our ſtoſe-porphyry, which, as it ſeems, he did not know; the *Hornblendſchieſer* (*Hornblende-ſlate* by *Kirwan*).

Other authors, as *Born*, *Ferber*, receive under this name, etimes different varieties of the *Thonſchieſer* (*argil- ous ſlate*) and ſometimes *Glimmerſchieſer* (*micaceous*
.

The firſt oryctologiſt who has awakened the attention of naturaliſts to the ſchiſtoſe-porphyry, and given of it an accurate deſcription was Mr. *Charpentier*, in his *Mineralogical Geography of the Electoral Dominions of Saxony.* At the ſame time he gave to it *excluſively* the name of Hornſlate, in which he was followed by moſt of the German mineralogiſts. But *Werner* thought otherwiſe. He left this name at firſt to that ſpecies of ſtone, which afterwards has been called *Kieſelſchiefer* (*ſiliceous ſlate*) and denominated that which is the ſubject of the preſent eſſay, *ſchiſtoſe-porphyry*, in order to diſtinguiſh it as a peculiar ſpecies of porphyry. In fact, it exhibits the mineralogical character of porphyry; as it principally conſiſts of an *homogeneous, hard, ſiliceous and argillaceous* aggregate, in which, though but ſparingly, and ſingly, are interſperſed ſmall *lamellæ of feldſpar*, beſides minute *grains of Hornblende*; yet at the ſame time it is diſtinguiſhed from the common ſpecies of porphyry, by its *groſs-ſlaty fracture.*—But ſince to the principal maſs of this ſtone the name of *Kling-ſtein* (*ſounding ſtone*) has been given, becauſe its larger plates, when ſtruck, give a *ſound* almoſt *metallic*; it ſeems that the name of *Klingſtein porphyr* (*klingſtone porphyry*) would be more characteriſtic and more conformable to analogy.

From this ſhort hiſtorical account it may ſufficiently be ſeen, what great uncertainty and want of accuracy has even of late prevailed in the geological knowledge of the mountainous part of the globe. For this reaſon, the editor of the *Magazine for the Natural Hiſtory of Swiſſerland* has highly merited the thanks of the public for having occaſioned, by means of a prize queſtion, that this intricate ſubject has been inveſtigated by two learned mineralogiſts *Karſten* and *Voigt*, and correctly explained in their two papers, crowned with the prize: On *argillaceous ſchiſtus*, *horn-ſlate*, and on *Wake*[*].

The klingſtone-porphyry belongs to that diviſion of mountains, which by modern geologiſts are claſſed with the *Trap-mountains*[†]. In Germany it breaks chiefly, in the middle mountains of *Bohemia*, in *Upper Luſatia*, and in the diſtrict of *Fulda*. It does not form coherent ranges of mountains, but always only detached maſſes of rocks and inſulated mountains, commonly on the ſide of ſimilar baſaltic mountains. It belongs to the moſt durable ſaxa, and reſiſts the withering in an eminent degree. Only on its ſurface ſome decay takes place, by which it acquires a pale clayey cruſt, the ſmoothneſs of which renders the aſcenſion on klingſtone porphyry mountains ſomewhat unſafe. Some of theſe mountains, though but ſparingly covered with fertile ſoil, are nevertheleſs well inveſted with plants and foreſt-trees, as for inſtance the *Donnerſberg* near Milleſchau, and the *Schloſsberg* near Töplitz. But moſt frequently the klingſtone-poryhyry occurs in the ſhape of cliffs which are dentated in a groteſque manner, from the unequal, moſtly vertical ſeparations into large plates and ill-formed pillars. Examples of ſuch groteſque rocks are:

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[*] Magazin für die Naturkunde Helvetiens, by Dr. *Höpfner*. Zürich, 1788, Vol. III. page 168, *ſeq*.

[†] In the German: *Trapp-formation*. This expreſſion is now, according to *Emmerling*, by the lateſt German mineralogiſts uſed to ſignify all mountains conſtituted of *grünſtein*, *amygdaloid*, *ſchiſtoſe-porphyry*, *baſaltes* and their *ſubordinate ſpecies*. All theſe are called *Trapp-gebirge*, ſince thoſe ſaxa not only occur in mountains of the ſame kind, but alſo very much agree in their *geognoſtic* relations; ſo that evidently they are of the ſame formation.—Tranſl.

the *Biliner-ſtein* near Bilin, and the *Engelhaus-Berg* not far from Carlſbad.

To complete the hiſtory of this ſtone, I muſt briefly notice an opinion which of late has been in vogue and even now ſeems to have its abettors. I mean, that the klingſtone-porphyry, as well as the baſalt, the amygdaloid (*Mandelſtein*) and other trap-mountains have been conſidered as *volcanic* productions, or *lava*. It does not belong to the object of the preſent inquiry, to repeat and to examine, what on both ſides of the queſtion has been argued, and ſometimes with violence diſputed. I ſhall only mention, that in the ſeveral attentive inſpections, with which I examined in the middle mountains of Bohemia the ſites of baſalt and klingſtone-porphyry, I could not diſcover any the leaſt veſtige of a crater or other ſigns of a volcanic nature: no more than any other unprejudiced obſerver would have been able to find.

To theſe ſhort geognoſtic remarks I ſhall now add the deſcription of the external characters of the maſs, which chiefly conſtitutes the klingſtone-porphyry.

The colour of the klingſtone is *grey*, now and then a little inclining to the green. It occurs only *maſſive*. It has a fine grain, an uneven, coarſe-ſplintery *fracture*, and burſts into thick-ſlaty fragments. The edges of its thin-ſplintery fragments are *tranſparent*. It is *pretty hard* and at the ſame time conſiderably tenacious. When triturated it yields a light-grey powder.

Its ſpecific gravity is 2.575.

The lamellæ of a greyiſh-white, ſtrongly ſplendent feldſpar, which are interſperſed in its ſubſtance, together with very minute cryſtals of a black horn-blende give to it character of porphyry.

SECOND SECTION.

I.

a) The klingſtone, in ſmall fragments which had pre- ouſly been freed to the utmoſt from the interſperſed feld- ar and hornblende, (in this ſtate it has been employed all the following experiments) loſt three *per cent.* of eight by ignition, during half an hour. Its greeniſh- ey colour paſſed into a lighter white-grey; but it has ffered no other change.

b) When expoſed to the vehement and continued heat the porcelain furnace, the klingſtone melts to a com- ct glaſs, both in the clay, and in the charcoal-cru- ble *.

II.

a) One *hundred* grains of finely powdered klingſtone ere mixed with a *cauſtic* lye, containing 250 grains of t-aſh, then inſpiſſated and ignited in a *ſilver crucible.* he mixture acquired at firſt a blackiſh colour, which ain gradually diſappeared. The ignited maſs was greeniſh, d ſo was the water with which I ſoftened it. *Muriatic id* added to ſuperſaturation diſſolved the whole of it and clearly. The muriatic ſolution likewiſe aſſumed a colour; but which on evaporation turned yellow dry, evaporated maſs was rediſſolved in water imp with a little muriatic acid, and the *ſiliceous earth* ſ by filtering. It weighed 57¼ grains when wa ignited.

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* See Eſſay I. of this work, pag. 22.

b) The muriatic fluid I precipitated by *cauſtic* niac and collected on the filter the produced light- precipitate. To the remaining fluid, of which I tralized the predominant ammoniac with muria I added *oxalate of pot-aſh*. A ſlight precipitate of oxalate of lime enſued, which collected and to a ſtrong red-heat left 2¼ grains of *pure calcareous*

c) The drained light-brown precipitate *b)* was a boiling ſolution of pot-aſh. It ſoon was taken ing a reſiduum in blackiſh-brown flocks, which I on the filter. The clear ſolution, when ſupe with muriatic acid and precipitated with *carbona* moniac, yielded *aluminous earth*: which, when ignited, weighed 23½ grains; and, when combi ſulphuric acid and pot-aſh, yielded pure ſulphat mine.

d) The reſidue, left undiſſolved by the lixiviu aſh, afforded with muriatic acid a yellow tinctu ſolution was put in a perfect ſtate of neutralizat treated with *ſuccinate of ſoda*, and the precipitated of iron collected and ignited. The *oxyd of iron* amounted to 3¼ grains.

e) What remained of this yellow fluid *d)* was th carbonate of ammoniac. This alkali threw down other ſmall portion of a yellowiſh-white earth, which peared black after ignition and weighed ¾ grain. By ution in ſome drops of muriatic acid, and ſubſequent mbination with ſulphuric acid, it yielded ſulphate of ne. That ſmall portion which remained of it, being mbined with ammoniac, then evaporated and ignited, t an oxyd of manganeſe behind, which imparted a clear nethyſt-colour to melting phoſphoric acid. The menoned ¾ of a grain may be eſtimated at ½ grain of *lime* and grain of *oxyded manganeſe*.

The preſence of manganeſe in klingſtone is indicated ven by the black and brown dendritical delineations, hich ſometimes are ſeen on the ſmooth ſurfaces of the rge plates or tables formed by the ſpontaneus diffiſions of e klingſtone porphyry.

III.

Finding, that the ſum of the products, obtained in this ecompoſition, was by far too ſhort of the weight emloyed of the foſſil, and thus ſhewed that another conituent part was to be ſought for, I made the following eriment.

a) Upon *three hundred* grains of finely triturated klingone I poured, in a retort, 600 grains of ſulphuric acid iluted with an equal quantity of water; digeſted the whole or a while, and diſtilled the fluid over to moderate dryeſs. The fluid in the receiver was poured back upon the eſiduum, a ſecond time digeſted and again abſtracted by diſtillation. The maſs left in the veſſel was then ſoftened by means of boiling water, the fluid filtered off; the reſidue on the paper, elixiviated, dried and ignited. It weighed ſtill 258 grains. As the merely ſiliceous part would have given no more than 171¼ grains; it was evident that the ſulphuric acid had been incapable of effecting a thorough decompoſition of the ſtone: as alſo could well be inferred even from the little change undergone by the reſidue.

b) On reducing, by evaporation, the ſulphuric ſolution, there appeared 10½ grains of ſulphated lime in thin needles; which being removed, I continued to evaporate the ſaline fluid, with a gentle heat, to the point of cryſtallization. But the cryſtals formed upon cooling, were unlike the regular cryſtals of alum.

c) Thoſe cryſtals, therefore, I diſſolved in water, mixed the ſolution with the liquor that remained on their cryſtallization, and precipitated the mixture with *cauſtic ammoniac.* When the light-brown precipitate had been filtered off, I evaporated the clear liquor to a dry ſalt. This was afterwards expoſed to a heat of ſo moderate a degree, that the ſulphate of ammoniac was enabled to volatilize ſlowly in thick vapours. A fixed ſalt of 22 grains weight, remained behind; which ſoon ſhewed to be *ſulphate of ſoda.*

Thus I have learned from this reſult, that *ſoda* is a co-conſtituent part in *klingſtone:* a diſcovery which is more remarkable on the conſideration, that this ſtone forms entire mountains in Germany; whereas *kryolite* the firſt ſtony foſſil, in whoſe mixture I have detected the preſence of ſoda, is with us but a foreign rarity.

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tinued notably predominant in the fluid.

c) Having reduced the ſaline maſs to a moderate dryneſs, I again diffuſed it in water; ſeparated the ſediment, which conſiſted of the generated ſulphate of barytes and the ſiliceous ingredient in the ſtone, by means of the filter; and ſaturated the clear fluid with ammoniac. The precipitate obtained was filtered off, the neutralized liquor evaporated to dryneſs, and upon this kept, in a porcelain veſſel, in a moderately intenſe heat, until all the ſulphate of ammoniac was gone off. The remaining fixed portion, when diſſolved in water and cryſtallized, proved to be *pure ſulphate of ſoda*. This was afreſh diſſolved, and decompoſed with *acetated barytes*; upon which the precipitated barytic ſulphate was ſeparated by filtration, the filtered clear fluid evaporated, and the dry acetate of ſoda heated to redneſs in a platina crucible. The coaly reſidue gave, by ſolution in water and filtration, a clear, colourleſs lixivium, which upon evaporation to ſiccity left 14 grains of dry carbonate of ſoda, in which the portion of *pure ſoda* makes 8$\frac{1}{10}$ grains. This, when neutralized with nitric acid, ſhooted entirely into rhomboidal cryſtals of nitrated ſoda.

Yet, it may be fairly ſuppoſed, that, in the natural compoſition of klingſtone, the ſoda exiſts in a ſomewhat greater proportion than is indicated by the quantity obtained. For, beſides that in general ſome loſs is unavoidable in the different operations, I think that already at the ignition of the barytes a certain portion of the ſoda is volatilized: which to ſuppoſe I am induced by the vapours, which, as I have mentioned before, viſibly eſcaped in a filamentous form on removing the lid of the veſſel.

After this preliminary remark I now return to the reſults from the analyſis of *klingſtone*.—Theſe, then, give

us

onſtituent parts and their proportions in the *hundred*, llows:

. . . .	II. a)		57.	25
ine	c)		23.	50
. . . .	b)	2. 25	2.	75
	e)	0. 50		
of iron	d)		3.	25
of manganeſe	e)		0.	25
. . . .	IV. c)		8.	10
r	I. a)		3.	
			98	10

he reflecting Natural Philoſopher will know, without ıggeſting it, how to appreciate the value of this diſ- ry of the preſence of ſoda, as a conſtituent part, in ne which occurs in maſſes of the ſize of entire moun- . It opens to him a new view, and leads him a ſtep farther in his geological inquiries. We now hat there is no longer any occaſion for the theory rto prevailing, according to which it was imagined ſſary to conſider all the *ſoda*, which in nature occurs r in a *free*, that is uncombined, or in the *carbonated* as an *educt* ariſing from a decompoſition of rock-ſalt, f ſea-ſalt, or of that from ſaline ſprings, ſuppoſed to been carried on by nature, and to have taken place in ıknown manner.

he klingſtone employed in the preceding experiments een knocked off from the *Donnerſberge*, near *Milleſchau*, ighеſt of the middle mountains in Bohemia. The le maſs of this majeſtic cone, which is above *two thou- five hundred feet* high, and from the ſummit of which ictureſque fields of Bohemia, extending to many ſquare [illegible] preſent themſelves [illegible] in a pleaſing miniature [illegible], at a farther diſtance on the [illegible] and Sileſian giant [illegible] Franconian *Fichtelgebirge* [illegible] abſolutely conſiſts from foot to [illegible]

[illegible], that in this enormous [illegible] nearly the twelfth part of the [illegible] will not be thought an exaggeration [illegible] is alone capable of providing, [illegible] of years to come, all Europe [illegible] preſuppoſing, however, that expedients [illegible] this alkali from the ſtone by [illegible]

CHEMICAL EXAMINATION

OF

BASALT[*].

(*Figurate trap* by *Kirwan.*)

A.

WITH the klingſtone-porphyry, in a geognoſtic view, is immediately connected the baſalt; the fancied *volcanic* origin of which has given riſe to the moſt violent controverſy, that ever was carried on concerning a geognoſtic ſubject. Already *Agricola* has conſidered baſalt, which muſt not be confounded with the *baſanites* of the ancients, as a fuſed lava, which during its fixation or congealing accelerated by a rapid cooling has aſſumed that cryſtallic columnar form, which ſo ſtrikingly characterizes this ſtone. This opinion, as is well known, has been revived towards the end of the laſt century by *Guettard*, *Ferber*, *Raſpe*, *Beroldingen*, and ſeveral others ſtill living, celebrated mineralogiſts; and has, from that time, under various modifications, been zealouſly defended againſt thoſe, who explain its formation in the *humid way*.

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[*] Read in the Royal Academy of Sciences at Berlin, 25th June, 1801.

On conſidering the very great external reſemblance of baſalt, to the compact lava, there is, perhaps, leſs reaſon to wonder, that this recently revived hypotheſis of the volcanic origin of baſalt has been ſet forth as a decided truth, by the greater number of geologiſts; and that every where extinguiſhed craters, have been thought to be found.

At preſent, however, it ſeems, this illuſion gradually loſes ground, and the ſtronger arguments reſulting from an unprejudiced obſervation of nature, which ſo evidently prove the formation of baſalt in the humid way, are more willingly liſtened to.

Inſtead of taking the baſalt for lava, and deriving its columnar form from a cryſtallization effected by fire, as was hitherto done, the reverſe is now, on cloſer examination, found to be the caſe: viz. that rather the baſalt itſelf with its kindred ſpecies of trap is the very material, which the more known volcanos eject changed to a melted lava.

On examining the refrigerated currents of lava, we find under the uppermoſt frothy cruſt, the more compact lava more or leſs porous, but the lowermoſt ſtratum perfectly compact without any air-holes. It would often be difficult to diſtinguiſh this laſt from the crude, not volcanized or original baſalt, were it not from the local ſituation which characterizes it as a real lava; though human art has not yet ſucceeded in eſpying the ſecret means which nature employs to ſoften the baſalt by volcanic fire to a paſte-like

ſubſtance,

ſtance, merely in ſuch a manner that after cooling no rk of its having been acted upon by fire remains.— he conjecture that ſulphur furniſhes the mollifying prin- ple, has, at leaſt, not yet reached to any high degree of obability.

However, it is neither the object of this eſſay, nor will s limits permit me to enter into a cloſer inveſtigation of is controverſy, which is equally intereſting, both in a *eological* and *geognoſtic* view. For this reaſon I only ſhall eclare, that from the reſults of my own obſervations made n baſaltic countries I am fully convinced, that nature has roduced baſalt in the humid way.

The ſpecimen of baſalt, employed in this analyſis, has een broken off from that perpendicular and coloſſal baſaltic pillar, which is expoſed to the day on the top of the *Haſenberg*, that moſt beautiful and moſt intereſting of the baſaltic mountains of Bohemia, near *Klappey*, in the vicinity of *Libochowitz*. This baſalt, as to its interior parts, appears to the naked eye ſo pure and homogenous, that in a mineralogical ſenſe it might without impropriety be conſidered as a ſpecies of a ſimple ſtone; though in the ſtrict ſenſe it is not really ſo, but is a maſs intimately mingled with ſpeckles of hornblende. It is but extremely ſeldom, that it contains minute grains of olivine. In the freſh fracture this baſalt is dark bluiſh-black, ſtrongly glittering, perfectly compact, burſting into indeterminate angular fragments, opake, hard, and difficult to be burſt. Its ſpecific gravity is: 3.065.

I.

a) Some ſmall fragments of baſalt were expoſed for half an hour to a rather ſtrong red-heat. The loſs of weight was two *per cent.* The colour was rendered lighter and the maſs more yielding to the peſtle.

b) Baſalt, when expoſed in an ordinary clay-crucible to the fire of the porcelain furnace, fuſed into a compact black-brown, and in thin ſplinters tranſparent glaſs.—In a crucible made of ſemi-indurated ſteatites (*Speckſtein*) it likewiſe entered into a thin fuſion. Part of it inſinuated itſelf into the clefts produced in the ſteatites; but the reſt was found cryſtallized in brown, ſhining, on the ſurface ſtriated and cellularly concreted lamellæ.—In the charcoal crucible it has been converted into a grey, dull, finely porous maſs, inlaid with abundant grains of iron.

II.

In the chemical decompoſition of baſalt my principal deſign was to aſcertain whether this ſtone, being geognoſtically allied with the klingſtone-porphyry, like this laſt, contains ſoda as a conſtituent part.

For this purpoſe *one hundred* grains of levigated baſalt were mixed with 400 grains of *nitrated barytes*, and treated in the ſame manner as has been fully explained in the preceding eſſay, 2 ſect. N. IV. on the decompoſition of klingſtone by barytes. I obtained in this experiment 4½ grains of dry carbonated ſoda, equal to 2.60 grains of *pure ſoda*.

III.

The other conſtituent parts I obtained in the following way.

a) *Hundred grains* of pulverized baſalt were ignited, r two hours with 400 grains of carbonated ſoda, in a rcelain-crucible, at a degree of heat at which the mixre would not fuſe. It coaleſced into a moderately hard am-yellow maſs, which being powdered, and ſoftened water, was neutralized with *muriatic acid*, then a little perſaturated with nitric acid, and evaporated to dryneſs. The dry maſs, which now had a ſaffron-yellow colour, vas diffuſed in water a little acidulated with muriatic acid, nd after a ſhort digeſtion filtered. The *ſiliceous earth* ft on the paper weighed after ignition 44½ grains.

b) The muriatic ſolution ſufficiently diluted with water, as precipitated, at a temperature of 212° Far. by means f carbonated ſoda. The drained precipitate was digeſted ith a lixivium of *cauſtic* ſoda, and the dark-brown reduum ſeparated by filtration. The alkaline fluid, when ombined with *muriatic acid* added in a ſmall exceſs, was recipitated with carbonate of ammoniac. By this maagement aluminous earth fell down, amounting to 16¼ rains when waſhed and ignited: and yielding pure ſulhate of alumine when treated with ſulphuric acid and ot-aſh.

c) The brown reſidue of *b)* I diſſolved in *muriatic acid*, arefully watching the preciſe point of ſaturation, and to e ſolution I added *ſuccinate of ammoniac* to precipitate e iron. The obtained ſuccinate of iron, when perctly elixiviated and briſkly ignited in a *covered* crucible, ave 20 grains of *oxyd of iron* attractible by the magnet.

d) The fluid thus freed from iron was treated, in a oiling heat, with carbonate of ſoda. The white preipitate produced was diſſolved in *nitric acid*, and the ſolution combined with *ſulphuric acid*, which threw down a conſiderable quantity of ſulphated lime. This being ſeparated, the remainder of the liquor was inſpiſſated almoſt to ſiccity, afreſh diluted with a mixture of water and ſpirit of wine, and the ſulphate of lime, then ſeparated, was added to the preceding: all that ſulphate of lime I decompoſed, by boiling with diſſolved carbonate of ſoda; and the carbonate of lime thus obtained, waſhed and deſiccated, weighed 17 grains, which indicate 9½ grains of *pure lime*.

e) Upon the fluid remaining from the laſt operation I affuſed *cauſtic* ſoda, and introduced the ſlimy precipitate, thereby procured, into *ſulphuric acid*, in which it readily diſſolved, yet tinging the ſolution with brown. I lodged this in a ſand-bath for evaporation. At the firſt impreſſion of heat, brown looſe flocks fell down and left the ſolution colourleſs. Thoſe flocks ſeparated by filtration proved to be an *oxyd of mangane ſe*; yet their ſlight quantity permitted only an eſtimation by gueſs at about ⅛ grain.

f) The ſmall quantity that yet remained of the fluid was evaporated to dryneſs, and the reſiduum expoſed in a ſmall crucible to a ſtrong red-heat. This upon rediſſolution in water, left another ſlight portion of *alumine*, both iron-ſhot, and contaminated with mangane ſe: weighing ½ grain in the ignited ſtate. But the clear ſolution entirely cryſtallized into ſulphate of magneſia. The earthy baſe of this ſalt, precipitated in the carbonated ſtate by means of carbonate of ſoda, weighed 6 grains; for which muſt be accounted 2¼ grains of *pure magneſia*.

From this analyſis of the *baſalt* from the mentioned pillar on the *Haſenberg* reſult the following conſtituent parts:

Silex	III.	a)		44. 50
Alumine		b)	16. 25	16. 75
		f)	0. 50	
Oxyd of iron		c)		20.
Lime		d)		9. 50
Magneſia		f)		2. 25
Oxyd of manganeſe		e)		0. 12
Soda	II.			2. 60
Water	I.			2.
				97. 72

With theſe reſults pretty well agree thoſe of the analyſis, which *Torbern Bergmann* has publiſhed in his valuable diſſertation: *De productis vulcanicis.* Namely:

Silex	50
Alumine	15
Lime	8
Iron	25
Magneſia	2
	100

Though *Bergmann* mentions the calcareous earth in the *carbonated* ſtate; yet he has omitted to prove that it is contained as ſuch in the compoſition of baſalt. But what concerns the *ſoda*, it is no matter of wonder that it has eſcaped his attention, ſince at that time it could not be ſuſpected that this alkali ſhould one day appear in the capacity of an eſſential co-conſtituent part of ſolid ſtones.

Beſides the above ſtated conſtituent parts, I think that in the baſalt as well as in its other kindred rocks I muſt acknowledge the preſence of another principle; which is, *Carbon.*—For, when after having introduced, into a red-hot crucible, finely pulverized baſalt mixed with three times its weight of nitrate of pot-aſh, and aſſiſted the decompoſition of the nitre by continuing the application of heat, I diſſolved the alkaline reſidue in water and combined the clear ſolution with ſulphuric acid, carbonic acid gas was extricated, eſcaping from the mixture in numerous ſmall air-bubbles. Hence the blackiſh colour of baſalt does not ſolely ariſe from the oxyded iron; but, undoubtedly, carbon likewiſe contributes to that colour of baſalt.

B.

It was not till after I had accompliſhed my analyſis of baſalt, that I became acquainted with that of Dr. *Kennedy*. The conſtituent parts educed by him from the *baſalt* of the *iſland Staffa*, and which in ſubſtance nearly agree with thoſe I found in the Haſenberg baſalt, are:

Silex	48
Alumine	16
Oxyd of iron	16
Lime	9
Soda	4
Muriatic acid	1
Water and volatile parts	5

As Dr. *Kennedy* has communicated the reſults of his analyſis to the *Edinburgh Society* already on the 5th of Auguſt, 1798, he has the merit of having the firſt given notice of the preſence of ſoda in baſalt as a component principle.

He mentioned not the magneſia. But ſince, on the other hand, he notices the muriatic acid as a conſtituent part, I was by this induced to try whether I ſhould not be able to find it alſo in the German baſalt.

With this view I triturated *two drachms* of *baſalt* from the *Haſenberg*, mixed them with *one ounce* of nitre from which any the leaſt trace of muriatic acid had previouſly been ſeparated by means of nitrated ſilver, and kept the mixture in a poliſhed crucible of iron expoſed to a ſtrong red-heat, until the greateſt part of the nitre appeared to have been decompoſed and alkalized. Upon this I diſſolved the melted maſs in water, filtered the fluid through elixiviated printing paper, and neutralized it with *nitric acid* of the pureſt ſort added to a ſmall degree of ſuperſaturation. Nitrate of ſilver, then dropped into it, produced a whitiſh turbidneſs. When after this the fluid had ſtood for ſome time in a warm place and again perfectly cleared up, I found a ſlight precipitate at the bottom of the glaſs, which moſt carefully collected weighed $\frac{3}{16}$ of a grain. This examined with the blow-pipe on the ſilver-ſpoon, fuſed not like pure muriated ſilver, but the greateſt part of it became reduced to metallic ſilver in minute globules, which by a certain interpoſed grey maſs were paſted together and prevented from uniting into a button. A ſlight preſſure ſeparated them, and it was only by means of a magnifying lens that the adhering grey maſs was rendered knowable as muriated ſilver. I, finally, diſſolved thoſe ſmall ſilver-grains in nitric acid and collected the remaining horn-ſilver as accurately as could be done.—It ſcarcely weighed $\frac{1}{26}$ of a grain: a quantity ſo ſmall as to indicate not even the *hundredth* part of a grain of muriatic acid.

CII.

9

Beſides the
in the baſalt as well
knowledge the
Carbon.—For,
hot crucible,
times its weight
compoſition of
heat, I diſſol
bined the
gas was ext
ſmall air-
not ſolely
carbon lik

MINATION

-STONE.

were formerly compre-
part of which is now more
-opals.

It w
baſalt,
The
iſland
thoſe

principally occurs in the valley
not far from *Meiſſen*, and even
mountains. Its *colours*, which
ſeveral varieties or ſhades of the
reddiſh, brown and blackiſh. It
Internally it is *ſhining* with a
rarely glittering. Its *fracture* is
paſſing into the coarſe-ſplintery.
interſected by a very fine fibrous
diſtinctly, if the ſtone be ſoaked
indeterminate ſharp-edged frag-
tranſparent, brittle and not very
is = 1.645.

A
lyſis
179
the

compoſition I employed a tranſparent
olive-green inclining variety of the *pitch-*

a) One

I.

a) One *hundred* grains of it, in coarſe fragments, were heated to redneſs during thirty minutes, in a *covered* crucible. They returned from the fire of a white-grey, marbled with iſabella-yellow, opake, chinky, of a meager and rough feel, though they had an appearance of glazing. They alſo loſt $8\frac{1}{2}$ grains of weight.

b) In the heat of the porcelain-furnace the pitch-ſtone fuſed, both in the charcoal and clay-crucible, into a clear glaſs full of minute froth-holes.

II.

a) One *hundred* grains of finely pulverized pitch-ſtone were inſpiſſated with a ſolution of 200 grains of *cauſtic* ſoda, in a ſilver crucible and kept for half an hour in a moderately ſtrong red-heat. The refrigerated maſs was white, bordering a little on the bluiſh. When ſoftened in water and ſaturated in exceſs with *muriatic acid*, I reduced it in a ſand-heat to a degree of dryneſs, diffuſed it again in water and threw it upon the filter. I obtained 73 grains of *ſiliceous earth*.

b) The muriatic ſolution was mixed with an over proportion of *cauſtic ſoda* and digeſted in a heat of ebullition; in which proceſs moſt of the precipitate, formed at the beginning, again diſſolved; yet leaving a brown reſidue behind. This being ſeparated, the alkaline liquor was neutralized and precipitated with *carbonate* of ſoda. The alumine, of which the precipitate conſiſted, was edulcorated,

rated, dried, and ignited. Its weight was $14\frac{1}{2}$ grains. The whole of it combined with ſulphuric acid and potaſh yielded cryſtals of alum.

c) That ſmall portion of the precipitate, which was left undiſſolved by the cauſtic lixivium *b*), I firſt diſſolved in *muriatic*, and then combined it with *ſulphuric* acid. Sulphate of lime was generated, which I collected and waſhed with weak ſpirit of wine. The filtered fluid again reduced to a ſmaller compaſs by evaporation, and combined with ſulphuric acid, gave another ſmall portion of ſulphated lime. The quantity of this together with the firſt weighed three grains; which indicate *one* grain of pure *lime*.

d) From the fluid, being now freed from the calcareous earth, the portion of iron which it yet contained was precipitated by *carbonate of ammoniac*. It weighed *one* grain The remainder of the fluid was evaporated to dryneſs; and on re-diſſolving the ſaline reſidue in water, *oxyd of mangancſe* ſeparated in fine, minute flocks, the ſlight quantity of which could not be eſtimated higher than at $\frac{1}{10}$ grain.

III.

One hundred grains of pulverized pitch-ſtone were mixed with 300 grains of nitrated barytes in cryſtals, and ignited in a porcelain veſſel until the latter had been entirely decompoſed. The refrigerated maſs, ſoftened in water, was firſt neutralized with *muriatic acid*, and then combined with ſulphuric acid in ſuch a proportion, that the latter, on evaporating the mixture and after the muriatic acid had been expelled by the heat, was ſtill predominant. The ſpiſſated maſs was elixiviated with hot water, the reſi-ium ſeparated by filtration, and the clear fluid ſaturated ith *carbonate* of ammoniac added in exceſs. After the ecipitate, produced by this means, had been filtered off, e fluid was reduced to a dry ſalt by evaporation, and its rtion of ſulphate of ammoniac volatilized in a porcelain ſſel expoſed to a moderate fire. A fixed ſalt remained, nſiſting of ſulphated ſoda. This being re-diſſolved and compoſed by *acetate of barytes*, I evaporated the filtered lution to dryneſs, and committed the dry ſalt to a red-eat in a *platina*-crucible. The ſaline reſidue, re-diſſolved, ltered and again evaporated to perfect ſiccity, gave *three* rains of dry carbonate of ſoda, amounting to 1¾ grains of *ire ſoda*; which neutralized with *nitric acid* ſhooted into ie uſual rhomboidal cryſtals of nitrated ſoda.

Therefore, *one hundred* grains of this *pitch-ſtone* from *Ieiſſen* conſiſt of:

Silex	II. a)	73.	
Alumine	b)	14.	50
Lime	c)	1.	
Oxyd of iron . . .	d) . . . ,	1.	
Oxyd of mangan eſe .	d)	0.	10
Soda	III.	1.	75
Water	I. a)	8.	50
		99.	85

CIII.

ADDITION

TO THE

CHEMICAL EXAMINATION

OF

PUMICE-STONE *.

ON a review of the great progreſs, by which modern ſcientific chemiſtry is ſo honourably ſignalized, it is impoſſible not to perceive the ſhare, which the analyſis of foſſils bears in it. By cultivating this important branch of chemiſtry, principles entirely new have been diſcovered, and ſubſtances already known have been found in natural combinations, in which their preſence has before not at all been ſuſpected. Remarkable inſtances of this laſt are given by *pot-aſh* and *ſoda*, both of which only of late have announced themſelves as pre-exiſtent eſſential conſtituent parts of ſolid ſtones; though conſidering their eaſy ſolubility and other ſaline properties, it is no great wonder, they could hitherto have eſcaped the attention of analyſts. But for the future it will not be allowed to conſider the analyſis of any ſtone complete, if regard has not alſo been had to theſe two alkalis. In like manner it will be found neceſſary to repeat ſome of the earlier ompoſitions of ſtones; more eſpecially of thoſe, wherein ſum of the ſeparated conſtituent parts ſhewed a notable icit from the original weight of the foſſil employed.

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* See Eſſay XXXIII, page 368, of this work.

The *pumice-ſtone* from *Lipari*, of which I have before s publiſhed an analyſis, ſeemed to me to deſerve ſuch epeated examination: notwithſtanding that the loſs of ight in the firſt, amounted only to 3½ *per cent* [*].

One hundred grains of it were reduced to powder, and th 300 grains of cryſtallized *nitrate of barytes* expoſed an intenſe red-heat, until the barytic ſalt was wholly ompoſed. The ignited maſs was powdered, drenched th water, diſſolved in *muriatic acid*, then ſuperſatu-ed with a ſufficient quantity of rectified ſulphuric acid, evaporated to dryneſs in a ſand-heat. Upon this the ſs was elixiviated with water, paſſed through the filter, the clear ſulphuric ſolution treated with carbonate of moniac. After the precipitate had been ſeparated by ration, the fluid was a ſecond time evaporated, and remaining dry ſalt ignited in a porcelain veſſel until ſulphated ammoniac had been entirely driven out. ere remained a fixed neutral ſalt. This was diſ-ved in water; the ſolution decompoſed by means of *tated* barytes, the fluid, after ſeparating the generated phate of barytes, evaporated to dryneſs, and the reſiduum mitted to a ſtrong red-heat. On a ſubſequent ſolution

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Before I could perform that ſecond analyſis, I received intelli-ce that Dr. Kennedy had chemically decompoſed pumice-ſtone found pot-aſh among its conſtituent parts. This analyſis he laid before the Royal Edinburgh Society on the 5th of February, 8.

in water, filtration and evaporation to dryneſs, ther mained five grains of a carbonated alkaline ſalt, whi I ſaturated with nitric acid and ſet by for ſpontan cryſtallization. The cryſtals thence ariſing proved b their rhomboidal form to be nitrate of ſoda. For thi 5 grains of carbonated ſoda, ſhould 3 grains of *pure ſoda* i put in the account.

But as the rhomboidal figure of thoſe cryſtals found in ſeveral parts to paſs into the priſmatic; I diſſolved al of them in a little water, and added to the lye a ſaturated ſolution of *tartareous acid*. A notable quantity o regenerated tartar (acidulous tartrite of pot-aſh) depoſited in ſmall grains; which ſhewed that the obtained *ſoda* was contaminated with *pot-aſh*, as already on ſeveral other decompoſitions of ſtones, in which I have found ſoda, I alſo perceived traces of pot-aſh.

To determine the proportion of pot-aſh to that of ſoda in pumice-ſtone, was not well practicable in this experiment, on account of the ſmall quantity.

However, by the reſult from this experiment the ſum of the conſtituent parts of *pumice-ſtone* was rendered more complete. Namely:

Silex	77.	50
Alumine	17.	50
Oxyd of iron, a little magneſiated .	1.	75
Soda and *pot-aſh*	3.	
	99.	75

CIV.

CIV.

CHEMICAL EXAMINATION

OF THE

JARGON FROM NORWAY.

(*Zircon* by the *Germans* and *French*).

THE diſcovery of *Jargon* in one of the moſt northern countries of Europe, is a remarkable mineralogical event, which on a geognoſtic conſideration is rendered ſtill more valuable by the circumſtance, that here the foſſil, for the firſt time, alſo occurs along with its matrix. For, as is known, the Jargon, as well as the hyacinth which is related with it, has hitherto been met with only in detached lumps on or under the vegetable earth *(Geſchiebe)*. It is found at *Friederichſwärn*, in *Norway*. Its matrix conſiſts of a coarſe-grained ſtony maſs, mixed of a reddiſh feldſpar and black baſaltic hornblende (*Amphibole* of *Haüy*),—in which it is ſparingly imbedded in tranſparent, light-brown cryſtals, belonging to the octahedral form.

I received this new foſſil from Norway firſt, from my deceaſed friend *Abildgaard*, of Copenhagen, under the name of *Veſuvian*, becauſe in ſome manner it reſembles the brown veſuvian from mount Veſuvius. But it was reſerved to the famous *Haüy* to give, by means of this foſſil, an emi-

nent

nent proof of his mineralogical ſagacity; inaſmuch as from the traced figure of its primitive integrant particles, (*molécules integrantes*), which is an irregular tetrahedron, in conjunction with its other characters, he concluded that it is a jargon. He has alſo introduced it, in his mineralogical work, as the eighth variety of the genus of jargon, with the name of, *Zircon souſtractif.*

The ſpecific gravity of this jargon I found to be, 4.485. It is abſolutely infuſible, and by ignition loſes merely its colour.

a) One hundred grains of it, powdered in a *ſteel-mortar*, and levigated finely with water in a *diſh of flint*, acquired from the laſt 1 grain of weight. — I inſpiſſated the powder, in a ſilver veſſel, with a lye containing 400 grains of *cauſtic* dry ſoda, and ignited it for half an hour. The refrigerated maſs had the whiteneſs of chalk. I drenched it with water, and ſuperſaturated it with *muriatic acid*; upon which I reduced the milk-white mixture to the conſiſtence of pap, diluted it again with water, and filtered it. The white, looſe, pulverulent reſidue on the paper, was afreſh boiled down with a lye holding in ſolution 200 grains of *cauſtic* ſoda, and ignited. After the re-diſſolved maſs had been combined with an exceſs of muriatic acid, and evaporated in great part, it had the appearance of a jelly-like ſubſtance. The reſidue, left by diffuſing it in water, and filtering, ſhewed the properties merely of *ſiliceous earth*, which, perfectly edulcorated, dried and ignited, weighed 34 grains; but from theſe muſt be deducted 1 grain acceſſory from the triturating diſh.

b) The muriatic ſolution, which exhibited a ſtraw-yellow colour, was treated with *carbonate of pot-aſh* ſucceſſively added, till the mixture, rendered turbid by its addition

dition, would no more become clear by ſtirring. A ſlight quantity of the ſame alkali ſuperadded, accompliſhed the precipitation of a white and proportionally very voluminous earth, which ſeemed to be capable of combining with only a very ſmall portion of the carbonic acid, diſengaged from the laſt portion of the pot-aſh. This earth when edulcorated, ſhrank on drying in a gentle warmth, into grey-white, tranſparent lumps, of a glaſs-like brittleneſs, and weighed 91 grains. To reduce theſe to the ſtate of powder, they were mixed and triturated with water, which they imbibed with a ſtrong crackling noiſe. After it had again been deſiccated in a warm place, it appeared as a ſubtle white powder.

c) This earth was now divided into two parts. The *one half* I diſſolved in muriatic acid, which required the aſſiſtance of digeſtion in a boiling heat. The ſolution was precipitated with a lixivium of *cauſtic ſoda*, and boiled with a large quantity of water. But nothing could be gained from the earth by this management. The fluid ſeparated by filtration admitted of being neutralized with the acid, and again combined with carbonate of pot-aſh, without any enſuing precipitation or turbidneſs. After the elixiviated earth had been re-diſſolved in muriatic acid, I evaporated it in a gentle heat for the purpoſe of cryſtallization. The whole of this ſolution ſhooted into thoſe acicular cryſtals, which are peculiar to the muriate of jargonia, yet were tinged yellowiſh by the iron ſtill combined with them. Upon re-diſſolving them in water, part of the ſolution was precipitated with carbonate of pot-aſh added in great exceſs. The precipitate entirely re-diſſolved in the ſuperabundant quantity of that alkali; it alſo continued diſſolved, even when expoſed to the influence of heat, and was re-produced only by neutralizing the ſolution with the

acid,

acid.—Hence, by this teſt alſo the earth proved to be the jargonia.

With the remaining part of the ſolution of the muriated jargonia I made experiments, with the deſign of ſeparating the ingredient iron. But I obtained no deciſive reſults from them. Neither the pure Pruſſian alkali (*Kali zooticum*), nor the neutral ſuccinates were applicable, becauſe both theſe reagents precipititate the jargonia together with the iron.

d) The *other half* of the jargonia *c*) was ſtrongly ignited in a *platina crucible*. It now weighed 33 grains, which makes 66 grains for the whole,

Inſtructed by experience, that the portion of iron ingredient in the jargon and hyacinth, cannot be entirely extracted by digeſting with acids the crude powder of thoſe ſtones, I omitted this previous operation, and tried to attain this end by ſublimation with muriate of ammoniac. With this view, I mixed the ignited earth of jargon with three parts of ſal-ammoniac, triturated the mixture with muriatic acid to a humid maſs, deſiccated it again, and ſublimed the muriated ammoniac in a ſmall matraſs, at a ſtrong heat. But the volatilized neutral ſalt had carried up along with it only a ſlight trace of iron, and the remaining muriated jargonia gave, with the Pruſſian alkali, a blue precipitate as before; only that it was a little paler. However, from other experiments it appears, that this method of ſeparating the iron from—*not ignited* jargonia, by repeated ſublimation with ſal-ammoniac might be of uſe.

But I imagine I ſhall not commit a very great error, if eſtimate the portion of iron at moſt at 1 *per cent*; hence e conſtituent parts of the *jargon* from *Norway* are,

Jargonia	65
Silex	33
Oxyd of iron	1
	99

is entirely *opake*; it gives a grey ſtreak; is but moderately hard, brittle, and eaſy to be burſt. The interſtices between the priſms are partially filled with whitiſh, very minute lamellæ of calcareous ſpar.

A more complete deſcription of the external characters of madreporite may be ſeen in the *Annals* publiſhed by *B. Moll**. According to a chemical analyſis communicated in the quoted book, 100 parts of it are ſaid to contain:

Calcareous earth	$63\frac{4}{16}$
Alumine	$10\frac{2}{16}$
Silex	$12\frac{8}{16}$
Iron	$10\frac{15}{16}$ *

But from this ſtatement of its conſtituent parts widely differs the reſult, which I had from my analyſis of the ſame ſtone.

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* Jahrbücher der Berg—und Hütten—Kunde. Erſter Band. Salzburg, 1797, pag. 291.

† To my great ſurprize I found in *Haüy's Traité de Mineralogie*, Tom. iv. pag. 378. the ſame conſtituent parts and their proportions, yet expreſſed in whole numbers, as the reſult of an analyſis of madreporite, made at Paris in the *Ecole des Mines*; *viz.*

Carbonate of lime	63
Alumine	10
Silex	13
Iron . . . . , ...	11
Loſs	3
	100

This great difference from my reſults induced me to repeat the analyſis of madreporite, yet I had again preciſely the ſame reſults. To this I ſhall add, perhaps unneceſſarily, that the very ſpecimen which I ſubjected to this analyſis, has been ſent to me by Baron *Moll* himſelf.

Under

I.

Under the blow-pipe the black colour of madreporite diſappears; the ſtone is ſoon rendered grey-white, aſſumes the ſtate of lime-ſtone mollified by burning, and affords, by ſlacking with water, a white milk of lime.

II.

a) *One hundred* grains of coarſely powdered madreporite were treated with *dilute nitric acid*, added in ſucceſſive portions. For this operation a glaſs-veſſel was uſed of a narrow aperture, and the balance put in equilibrium. The ſolution proceeded with a conſiderable efferveſcence, and at the ſame time coal-black, light, tender flocks ſeparated. The quantity of carbonic acid gas which eſcaped, amounted to 43 grains. A blackiſh, ſandy reſidue, weighing 6 grains was left behind.

b) From the filtered ſolution *cauſtic* ammoniac has precipitated ſome brown flocks, which were *oxyd of iron*. The clear fluid, by expoſure to the air, became again turbid after a few days, and depoſited a ſubtle *oxyd of manganeſe*, of ſo ſmall a quantity as not to admit weighing. This being ſeparated, the ſolution was again a little ſuperſaturated with *nitric acid*, and, in a hot ſtate, treated with carbonate of ammoniac. The precipitated earth, when edulcorated and dried, amounted to 93½ grains, and formed ſulphate of lime with dilute ſulphuric acid. The mixture was evaporated to dryneſs, moderately ignited, and extracted with a ſmall quantity of water, which, upon evaporation, left a little ſulphate of magneſia behind. Yet the *carbonate of magneſia*, ſeparated from this compound, ly ½ grain; ſo that on deducting this, there grains for the *carbonated calcareous earth.*

ne reſidue left on the ſolution of the crude foſſil in ic acid *a*) was put on a teſt moderately heated. It lt its black colour, and *one half* grain of weight. ſs this loſs aroſe from the portion of *carbon*, which the black colour to madreporite. The reſiduum was racted by means of *muriatic acid*; which left 4½ grains ſiliceous earth. *Carbonate of ammoniac* threw down, m the muriatic ſolution, *carbonate of iron*, which, gether with that obtained before *b*), weighed 1¼ grains.

Hence *Madreporite* conſiſts in the *hundred*, of,

Carbonate of lime . .	II. *b*) . .	93
Carbonate of magneſia .	—— . .	0. 50
Carbonate of iron . .	— *c*) . .	1. 25
Carbon (radical) . .	—— . .	0. 50
Arenaceous ſilex . . .	—— . .	4. 50
Oxyd of manganeſe, a trace		
		99· 75

CVI.

a) *One hundred* grain
were treated with *dil*
portions. For this c
narrow aperture, a
ſolution proceede
at the ſame tim
The quantity
to 43 grains.
was left be

al wl
prismatic,
ometimes in the
ar manner; it alſo n
ic inveſtment. Mr. *Se*
ar attention to this foſſil, a

b) Fr periments, ſuſpected it to be
cipitate jecture is fully confirmed by the
The to perform which, Mr. *Selb* hi
bid me the neceſſary quantity.

The mineralogical Public has already
ient deſcription of the external characte
from Mr. *Selb* *, and *Karſten* †; to whi
refer the reader.

ame end, ſingle or detached cryſtals,
ity only at 2. 536.

t the name *Pharmacolite*, ſuiting this
ſiderable quantity of arſenical, or
ins.

ere mixed with
to redneſs in a
s of metallic arſenic

extracted by *nitric acid*, the filtered
by evaporation, and treated with ſulphuric
lded ſulphate of lime.

B.

oofs of the preſence of arſenical acid and
in the foſſil, as conſtituent parts, I at-
tain their proportions in the following

d grains loſt, by being moderately heated
ucible, 22½ grains. As in this operation,
nell nor by the ſight, any volatilization of
ld be obſerved, this loſs of weight muſt
by the eſcaping of the water of cryſtalliza-
ther hand, the ſpecimens had undergone
by this heating, except their ſurface being
duller. But the places, ſpotted red from
had now aſſumed a light-bluiſh colour.

b) Thoſe 77½ grains which remained after the ignition, diſſolved in *nitric acid*, leaving a grey reſidue of 6 grains of ſiliceous, mixed with argillaceous earth.

c) The filtered nitric ſolution, which ſomewhat inclined to the reddiſh, was evaporated to a ſmaller volume, and mixed with a ſolution of *acetate of lead* as long as any precipitation enſued. The precipitate, when collected, waſhed and dried at a raiſed temperature, weighed 138 grains. It conſiſted of arſeniated lead.

Agreeably to a counter-experiment, in which 100 grains of dry acid of arſenic, diſſolved in water and combined with the quantity of acetated lead requiſite to effect a ſaturation, yielded 297 parts of arſeniated lead, thoſe 138 grains mentioned before, indicate 46½ grains of *concrete acid of arſenic*.

d) What remained of the fluid after the ſeparation of the precipitate, together with the waſhings *c*), was evaporated to ſome degree, during which *green* coloured borders appeared on the inner ſurface of the veſſel. In order to ſeparate the ſmall quantity of undecompoſed acetate of lead, it might yet have contained, I added the requiſite quantity of *muriatic acid*. When upon farther evaporation no muriate of lead any longer appeared, I mixed the fluid with *ſulphuric acid*. This produced a copious precipitate of ſulphated lime, which being collected on the filter, waſhed with weak ſpirit of wine and heated to redneſs, weighed 54 grains. Therefore, ſince in 100 parts of ignited gypſum the pure calcareous earth amounts to 42½ parts, the mentioned 54 grains determine the portion of *lime* contained in the foſſil examined at 23 grains.

e) The remainder of the liquor was neutralized with carbonate of ſoda, and reduced to the ſtate of ſiccity. On re-diſ-ſame end, ſingle or detached cryſtals, gravity only at 2. 536.

thought the name *Pharmacolite*, ſuiting this ſe of the conſiderable quantity of arſenical, or cid which it contains.

A.

One hundred grains of pharmacolite were mixed with grains of powdered charcoal, and heated to redneſs in a ſmall retort. Upon cooling, 6 grains of metallic arſenic were found ſublimed.

b) The reſidue was extracted by *nitric acid*, the filtered ſolution reduced by evaporation, and treated with ſulphuric acid.—It then yielded ſulphate of lime.

B.

After theſe proofs of the preſence of arſenical acid and calcareous earth in the foſſil, as conſtituent parts, I attempted to aſcertain their proportions in the following way.

a) *One hundred* grains loſt, by being moderately heated in a porcelain-crucible, 22½ grains. As in this operation, neither by the ſmell nor by the ſight, any volatilization of any principle could be obſerved, this loſs of weight muſt have been cauſed by the eſcaping of the water of cryſtallization. On the other hand, the ſpecimens had undergone no other change by this heating, except their ſurface being rendered a little duller. But the places, ſpotted red from the cobaltic cruſt, had now aſſumed a light-bluiſh colour.

b) Thoſe

CVII.

CHEMICAL EXAMINATION

OF

SCORZA.

AMONG the various remarkable mineral products of Tranſylvania, which I received through the kindneſs of Mr. *Müller von Reichenſtein*, of *Zalathna*, there exiſts an arenaceous foſſil of a *piſtaccia-green* colour, approaching to the *ſiſkin-green*, exhibiting *fine*, *green*, quite *dull* and *meager* grains. This ſand occurs in a valley, in the vicinity of the village *Muſka* (ſay, *Muſchka*) ſituated upon the river *Aranyos* (ſay, *Aranjoſch*), where it is ſeated in ſmall neſts or cluſters, in a grey argillaceous ſtone. The *Wallachians* call it *Scorza*; which denomination it is adviſeable to preſerve as a *ſpecific name*. Mr. *Müller* adds, in his manuſcript note, this *ſand*, *as to colour and form*, *ſo much reſembles various* pounded and waſhed auriferous ores (*Puchgöldern*), *that gold in a pulverulent ſtate might very eaſily be adulterated by its admixture; were it not that its leſs ſpecific gravity enables the gold-collecting officers to detect the fraud, which already has been often attempted.*

Its ſpecific gravity is = 3.135.

It is, viſibly, mixed by nature with white grains of quarz; which to ſeparate, their exceſſive minuteneſs does not permit.

a) *Two hundred* grains of ſcorza, heated to redneſs, loſt
grains of weight, and the greeniſh-yellow colour had
ſed into a light-brown.

b) The reſidual 195 grains were ground fine, and ignited
th three times their weight of *cauſtic* pot-aſh. The maſs
uld not fuſe, and appeared, upon cooling, of a ſmutty
en. I ſoftened and filtered it. The fluid poſſeſſed a fine
ſs-green colour. But expoſed in a flat diſh to the
noſphere, it became within a ſhort time diſcoloured, and
fall an *oxyd of manganeſe* in looſe, brown flocks, weigh-
; ½ grain after ignition. This oxyd conveyed into a
arl of melting phoſphoric acid, imparted to it a topaz-
llow; but by detonating upon it a little nitrate of pot-
, it acquired a colour mixed of amethyſt-red and dark-
en.

c) Upon the powder elixiviated, and exhibiting a
ldiſh-brown colour, I affuſed *muriatic acid*, in which the
hole of it readily diſſolved. To this ſolution I added that
ivium of pot-aſh which had yielded the manganeſian
yd, and which I had previouſly neutralized with muriatic
d; which done, the whole was evaporated to dryneſs.
n diffuſing it in water, *ſiliceous earth* ſeparated, to the
ount of 86 grains when collected, waſhed, and ig-
ted.

d) The fluid now freed from the ſilex, was mixed with
uſtic ammoniac, ſo as to be a little ſuperſaturated, and
precipitate produced was directly collected upon the
rum and waſhed. The colourleſs fluid ſeparated from
on being combined at a heat of ebullition with *carbonate*
ſoda, yielded a precipitate of carbonated calcareous earth,
ighing 51 grains after waſhing and deſiccation. Theſe,
en briſkly ignited, left 28 grains of *lime* or pure calcare-
earth.

e) The brown precipitate obtained by means of *cauſtic ammoniac*, and which conſiſted of aluminous earth and oxyded iron, was digeſted ſtill moiſt with a lye of cauſtic pot-aſh, which took up the alumine and left the oxyd of iron. This latter being collected on the filter, and, after ſufficient edulcoration ignited, weighed 33 grains, the whole of which obeyed the magnet.

f) The alkaline fluid *e*) was ſaturated to exceſs with *muriatic acid*, and decompoſed in a ſtate of ebullition by means of carbonated ſoda. The precipitated *aluminous earth*, waſhed and ignited, amounted to 42 grains. By ſolution in ſulphuric acid, and combination with acetate of pot-aſh in proper proportion, it furniſhed pure alum.

Hence *one hundred* parts of *Scorza* conſiſt of,

Silex	*c*) . .	43
Alumine . . .	*f*) . .	21
Lime	*d*) . .	14
Oxyd of Iron . .	*e*) . .	16. 50
Oxyd of Mangane ſe	*b*) . .	0. 25
Loſs by ignition .	*a*) . .	2. 50
		97. 25

NATION

TE OF BARYTES.

hich has been given me as a ſcarce
comes from *New-Leiningen*, in the
ght it deſerving a cloſer examination;
that it is not a native oxyd of zinc,
barytes. However, it will appear from
of its external characters drawn up by *Kar-*
h reſpect to its external appearance, it differs
her ſpecies of barytes, and that, on this account
in the ſyſtematical arrangement of minerals, to be
nder the genus of barytes as a *new* and particular

The *fibrous barytes* is,

on the freſh fracture *cheſnut-brown*;
has a ſhape partaking of the *kidney-form* and
and *botryoidal.*

Its ſurface and external luſtre not determinable, becauſe the foſſil ſeems here to have been impaired by attrition.

Internally, *little ſhining*, of a *greaſy gloſs.*

Fracture *coarſe fibrous*, the fibres *diverging* in a *feather-like* manner *).

Fragments, indeterminate angular,
of indiſtinctly detached, thick and coarſe-grained pieces.

Tranſparent on the edges.
Soft,
heavy.

Its ſpecific gravity I found to be, 4. 080.

a) Before I proceeded to the decompoſition of the quantity of this foſſil deſtined for this purpoſe, I ſeparated, by means of acetic acid, the calcareous earth, which externally ſtuck in the cavities formed by the botryoidal ſhape. *Three hundred* grains of it were powdered, boiled with 600 grains of carbonate of pot-aſh and water, evaporated to dryneſs; again diffuſed in water, and a ſecond time evaporated. Upon ſubſequent dilution with water, the earth was ſeparated by the filter and waſhed. This earth was treated with *muriatic acid*, which diſſolved it with effervefcence, leaving a reſidue of 18 grains. A ſecond boiling with pot-aſh in the ſame manner as before, entirely decompoſed theſe 18 grains; and the ſeparated earth now entirely diſſolved in muriatic acid. The muriatic ſolution evaporated to the point of cryſtallization, conſtantly gave muriate of barytes in its uſual tabular form.

b) All this muriated barytes was re-diſſolved in water; the predominant pot-aſh of the mentioned alkaline lye, which

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* Such a manner of divergence of fibres I have not met with before, whoever is acquainted with the *plumoſe-ſtriated ſurface*, will alſo know what is underſtood by the expreſſion, in a *feather-like manner divergingly fibrous.*

compoſed foſſil,
s mixed.
was repro-
g, amounted
of the foſſil
of 1 *per cent.*
rytic ſulphate, a
by Pruſſiate of

CIX.

CIX.

CHEMICAL EXAMINATION

OF THE

TABULAR SPAR

(Tafel-ſpath.)

THE *tabular ſpar* commonly occurs in a mingled mass of brown cryſtallized garnets, and blue calcareous ſpar, along with which it conſtitutes more or leſs the third part of the aggregate. It poſſeſſes a milk-white colour, and conſiſts of ſeparate, [illegible]-grained pieces, very implicated in each other. Mr. *Karſten*[*], who mentions them as a [illegible] of regularity, [illegible] was [illegible] before, [illegible] them of a [illegible] form, and their ſeparating [illegible] a [illegible] very [illegible]. Mr. Stütz[†], who [illegible] brought this foſſil [illegible], has given it the name of [illegible] *ſpar*, because it breaks in [illegible], ſomewhat [illegible]. Mr. *Karſten* called it [illegible]; yet [illegible] it in his newest tables with the preceding name.

Mr. Stütz [illegible] this foſſil [illegible] at Dognatzka in the Bannat of Temeſwar. [illegible], on the contrary, [illegible]

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[*] Mineral. Tabellen. 1800. pag. [illegible]

[†] [illegible] k. k. Natur. Sammlung zu Wien. 1793, pag. [illegible]

[illegible]

Oravicza as the place of its occurrence. This meritorious mineralogical writer alſo conjectured that it belongs to the common *tremolite*; but the following analyſis will ſhew, that Mr. *Karſten* was more correct in ranking it as a particular ſpecies under the *genus of ſilex.*

a) *One hundred* grains of tabular ſpar in pure ſpecimens, which had been carefully freed from the concomitant blue calcareous ſpar, were pulverized and introduced into a matraſs, previouſly counterbalanced, together with 400 grains of nitric acid. The volume of the powdered ſtone gradually diminiſhed, but no efferveſcence, nor loſs of weight, enſued.

b) The reſidue, which had a ſlimy appearance, was collected upon the filter, waſhed, and ſubmitted to a red-heat. It weighed 50 grains, and was pure *ſiliceous earth.*

c) The diluted nitric ſolution was not rendered turbid either by ſulphuric acid or by cauſtic ammoniac. I treated it then with carbonate of ammoniac. The precipitate, waſhed and dried in a warm temperature, amounted to 82 grains, conſiſting of *carbonated calcareous earth.* But as it is not contained in the foſſil in the carbonated ſtate, we muſt reckon for it only 45 grains. The conjecture that a little of magneſia might be preſent in the foſſil, proved abortive upon farther inveſtigation.

e) Another portion of the tabular ſpar, weighed and expoſed to a red-heat, loſt by this proceſs 5 *per cent.* of weight. As the calcareous earth in the foſſil is not carbonated, that loſs is to be derived from the aqueous particles driven out by the ignition.

Conſequently *one hundred* parts of the *tabular ſpar* c ſiſt of,

Silex	50
Lime	45
Water	5
	100

CI

CX.

CHEMICAL EXAMINATION

OF

MIEMITE.

MIEMITE was ſo denominated from *Miemo*, in Tuſany, where Dr. *Thomſon* diſcovered it in the year 1791. The ſpecimen he ſent me was inſcribed: *Spath mageſien.*

A.

External Deſcription of Miemite.

Karſten has given the following deſcription of the exernal characters of it:

Miemite is,

as to colour, of a pale *ſparrow-graſs* green, fading into the greeniſh-white;

occurs *maſſive*, *cryſtallized in flat*, *double*, *trilateral pyramids*, joined baſe to baſe. Some of the cryſtals are of a middle ſize, others are ſmall; they alſo have their lateral edges either agglutinated, or they croſs each other.

They exhibit a *druſy* external ſurface, which internally is *ſtrongly ſplendent*, of the *luſtre of mother of pearl.*

Its fracture *foliated* curvilinear; its
fragments indeterminate angular, rather ſharp;

Detached pieces groſs—and alſo coarſe grained: the
grains *longiſh*, *acute angular*.

It is *tranſparent*,
ſemi-hard,
brittle,
not very heavy.

B.

Chemical Analyſis of Miemite.

a) One *hundred* grains of Miemite were ground fine and covered with *nitric acid*. In the cold the action of the ſolvent was but ſlow, and attended with only a weak efferveſcence. On the application of heat, the ſolution was rapidly accompliſhed, with a very violent efferveſcence. Only a few brown flocks remained, which likewiſe diſſolved in the muriatic acid added by drops.

b) The ſolution was combined with *cauſtic ammonia* to ſuperſaturation. The brown precipitate obtained, being waſhed, was boiled while yet moiſt with a lixivium of *cauſtic ſoda*; but which met nothing ſoluble in it. The ſame precipitate was now again edulcorated, then diſſolved in *ſulphuric acid*, evaporated to a dry maſs, and this laſt ignited during half an hour. Upon its re-diſſolution in water, brown-red flocks remained, which after ſuſtaining a ſecond ignition, weighed 2¼ grains, and were oxyd of iron, together with a ſlight indication of manganeſe. As there is no doubt but the iron is contained in the foſſil in the carbonated ſtate; 3 grains of *carbonated oxyd of iron* muſt be accounted for it. The fluid from which this oxyd has been ſeparated, cryſtallized to ſulphate of magneſia.

c) That fluid which afforded on the addition of ammoniac the above brown precipitate, was combined in a boiling heat with carbonate of pot-aſh. By this management a white and light earth fell down, which upon edulcoration, was treated with dilute ſulphuric acid. This produced a quantity of ſulphate of lime, which I carefully collected and decompoſed, by boiling it with a ſolution of carbonated ſoda. The *carbonated calcareous earth* thus procured, weighed 53 grains, when waſhed and deſiccated in a warm place.

d) What remained of the fluid after the ſulphate of lime had been ſeparated, ſhooted on farther evaporation into cryſtals of ſulphated magneſia. This, together with that obtained in the proceſs related *b*), I decompoſed in a boiling heat by carbonated ſoda. The quantity of *carbonated magneſia* which I here obtained, being edulcorated and dried with the aſſiſtance of a gentle heat, amounted to 42½ grains.

e) *One hundred* grains of the ſame miemite in entire ſpecimens, were expoſed in a covered crucible, to a ſtrong red-heat during 30 minutes. They were rendered ſoft by the action of the fire, had acquired a dark iſabella-yellow, and loſt 52 grains of weight.

Yet, ſince the whole weight of the carbonic acid contained in the mentioned 53 grains of calcareous earth, as well as in the 42½ grains of magneſia, and in the 3 grains of oxyded iron, conformably to the uſual proportions, can amount only to 39 grains; it is obvious, that the ſurplus of 13 grains loſt by the ignition, muſt be conſidered as *aqueous particles* expelled. Of theſe, in fact, we again find the greateſt part in the carbonated magneſia. For, the quantity of water with which this earth, while precipitating, combines ſo intimately, that it parts with it only at a red-heat at which alſo its carbonic acid is driven out, amounts in 100 parts of carbonated magneſia to 27; while the carbonic acid contained in it amounts to but 33.

The conſtituent parts of *Miemite*, therefore, are in the *hundred*:

Carbonate of lime	53.
Carbonate of Magneſia	42.50
Carbonate of iron, a little magneſiated	3.
	98.50

This near agreement of the conſtituent parts of *Miemite* with thoſe of the *Tyroleſe magneſian ſpar* *, ſhews that the former ought to be conſidered only as a ſubordinate ſpecies of the ſecond, and claſſed under it as under its genus.

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* See Eſſay XXI. of this work, pag. 259.

CXI.

CXI.

CHEMICAL EXAMINATION

OF THE

PRISMATIC MAGNESIAN SPAR.

(Stänglicher Bitter-ſpath.)

THE foſſil here under examination, which is met with, though but rarely, in the cobaltic mines at *Glückſbrunn*, in the territory of Gotha, has firſt been made known and deſcribed by Mr. *Schlotheim*, of *Gotha* *. Its *external deſcription*, which I here ſubjoin, has been given by *Karſten*, who alſo gave it the name of *Priſmatic magneſian ſpar*.

> "It is throughout of a *ſparrow-graſs green*; but in moſt varieties *darker* than in *Chryſoberyl*, and extremely ſeldom ſo pale as the conchoidal *apatite* (*Spargelſtein*) from the *Cape de Gates*.
>
> It is cryſtallized in ſomewhat *flat*, almoſt perpendicular tetrahedrons, the lateral edges of which are much truncated. The cryſtals are only ſmall or

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* *Hoff*'s Magazin für die geſammte Mineralogie, &c. Leipzig, 1801. Vol. I. pag. 156.

very ſmall; and ſometimes they form only *druſy ſurfaces*. They are ſeen having the baſe of the tetrahedron imbedded, and ſometimes preſent a reniform accumulation.

The lateral facets of the tetrahedrons are *grained*, and but *little ſhining*. The ſurfaces of the truncations, on the contrary, are *ſmooth* and *ſtrongly ſplendent* of the luſtre of mother of pearl. It is from this, that the laſt mentioned ſtrike moſt the eye.

Internally the priſmatic magneſian ſpar is *ſplendent* of a glaſſy luſtre.

Its fracture paſſes *wholly from the indiſtinct foliated into the ſplintery*.

It burſts into indeterminately angular, not very ſharp edged fragments.

It exhibits *priſmatic ſeparate pieces*, (which in ſome varieties of it are *imperfect*, yet ſufficiently diſtinct).

It is much *tranſparent*;
Semi-hard, in rather a *high degree*;
gives a ſnow-white ſtreak, and
is not very heavy."

Its ſpecific gravity, as I found, is, 2. 885.

Some ſpecimens of this foſſil were ſtrongly ignited for half an hour in a *platina crucible*; and then returned from the fire without having been burſt, but rendered very ſoft and opake. They exhibited various colours alternating in zones in ſuch a manner, that the exteriour circle was iſabella-yellow, the ſecond yellowiſh-brown or reddiſh white, and the nucleus clove-brown. They ſtill preſerved ſome luſtre, and the pieces detached in priſms were diſtinctly eccentric. The loſs of weight amounted to 45½ *per cent.*; though by this degree of ignition, as will appear from the ſequel, the whole of the carbonic acid had not been expelled.

The chemical decompoſition of this mineral ſubſtance I accompliſhed in the manner as follows:

a) *One hundred* grains were finely triturated, and introduced into a tall, cylindrical glaſs, which held a quantity of *nitric acid* ſufficient to effect the ſolution, and was previouſly put in equilibrio. The acid acted but feebly, the ſolution proceeded but ſlowly, and was accompanied by no great effervеſcence. After the end of the ſolution, which required ſome hours, a loſs of weight of 47¼ grains was found, owing to the *carbonic acid* which had eſcaped.

b) The ſolution was at firſt yellowiſh, but colourleſs when diluted with water. Its clearneſs was not diſturbed by adding a few drops of ſulphuric acid; as a proof that it contained neither barytic, nor ſtrontian earth, which laſt has been ſuſpected to exiſt in this foſſil. I mixed it with as much of carbonated pot-aſh as was neceſſary to neutralize its predominant acid; and then precipitated the ferrugineous part by *ſuccinate of ſoda*. The precipitated ſuccinate of iron, when collected and ignited, left a fine metallic baſe of the form and appearance of a very looſe red *cream of iron**; but all of which obeyed the magnet. After a few drops of oil had been burnt over it, it preſented itſelf as a black oxyd of iron, weighing 2½ grains. But ſince the iron exiſts in this foſſil in the *carbonated ſtate*, we muſt reckon 4 grains for it.

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* In precipitations the precipitate either ſinks to the bottom by its ſpecific gravity, or is ſo light as to float on the liquor. In the latter caſe it is called *cream*, as here *cream of iron*. Thus the pel-

c) I now precipitated the ſolution, thus freed from iron, with *carbonated pot-aſh* and the aſſiſtance of a boiling heat. The white precipitate obtained, amounted to 96½ grains, when waſhed and dried in a warm temperature.

d) This precipitate I perfectly ſaturated with weak ſulphuric acid. By this, ſulphate of lime mixed with ſulphate of magneſia was generated, I inſpiſſated this mixture, by the application of heat, to a dry maſs; and upon this elixiviated it carefully with cold water. After gentle evaporation, the filtered fluid entirely ſhooted into cryſtals of ſulphated magneſia. This laſt re-diſſolved in water, and decompoſed in a heat of ebullition by means of *carbonate* of pot-aſh, gave 36½ grains of edulcorated, and in a gentle warmth, dried *carbonate of magneſia*; which deducted from the preceding 96½ grains, reduces the amount of the carbonate of lime to 60 grains.

I have, therefore, from thoſe decompoſed *hundred* grains of the priſmatic magneſian ſpar obtained,

Carbonate of lime	60 grains.
Carbonate of magneſia	36. 50
Carbonate of iron	4.
	100. 50

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licle of carbonated lime, which is formed and floats on lime-water expoſed to air, is termed *cream of lime*, in contradiſtinction to *milk of lime*, which is calcareous earth diffuſed in water to the conſiſtence of milk. A ſimilar inſtance is afforded by *cream of tartar*. —Tranſl.

However, ſince the quantity of carbonic acid, combined with thoſe proportions of the three conſtituent parts here ſtated, amounts only to 40½ grains, and in particular in the

60.	grains	of carbonated lime,	to	27 grains.
36.½	do.	carbonated magneſia	—	12.
4	do.	carbonated iron,	—	1. 50
				40. 50,

whereas the crude foſſil itſelf contains 47 ¼ grains *a*), hence 6¾ grains more: ſome correction in the above ſtatement is neceſſary, and this relative to the proportion of the carbonic acid combined with the magneſia.

The carbonate of magneſia, prepared in the uſual way by precipitation from acids, contains upon average 40 *per cent.* earth, 27 water, 33 carbonic acid. But this earth, like pot-aſh and ſoda, is capable of appropriating to itſelf a greater proportion of carbonic acid. For, if carbonated magneſia, when recently prepared and ſtill moiſt, be diffuſed in water, poured into a capacious bottle filled with carbonic acid gas and agitated, the volume of the gas will be found to decreaſe in a much greater proportion, than can be abſorbed by the quantity of water employed to drench the earth. Thus *ſoda*, perfectly ſaturated with carbonic acid, whether by nature or by art[*], contains leſs water of cryſtallization, in proportion as the quantity of carbonic acid combined with it increaſes. From analogy it was reaſonable to conjecture, that the ſame is the caſe with magneſia; and this ſuppoſition is confirmed by the greater proportion of carbonic acid, diſcovered in that

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[*] Eſſay LXXVIII. page 65.

magneſia, which is a co-conſtituent part of the foſſil t examined.

If now we determine by computation the proportion the earths and oxyded iron in a ſtate of purity, amounts in the above mentioned

60	grains of	*Calcareous earth*	to	33 grains.
36.½	do.	*Magneſia*	—	14.50
4	do.	*Iron*	—	2.50
				50.
Adding		*Carbonic acid*		47.25
				97.25
Conſequently, for the proportion of *water* remain only				2.75
				100.

According to this calculation, *one hundred* grains of the *priſmatic magneſian ſpar* contain:

Lime	33.
Magneſia	14.50
Oxyd of iron	2.25
Carbonic acid	47.50
Water, and perhaps ſome loſs	2.75
	100.

CXII.

STRIATED GREY ORE OF MANGANESE.

I.

Ore of Mangāneſe from Ilefeld.

THE *grey ore of mangāneſe,* which occurs at *Ileſeld,* on the *Harz,* along with the ponderous-ſpar (*ſulphate of barytes*) is particularly diſtinguiſhed by its ſtrong metallic luſtre and the ſize of its cryſtals, which are oblique quadrilateral columns, ſometimes *two* inches and above long. Specimens of this kind at firſt ſight often exhibit an illuſive reſemblance to the Hungarian long ſtriated, cryſtallized grey ores of antimony. The bright luſtre of this manganeſian ore from Ilefeld, has, by ſome, been conſidered as an indication of iron admixed in a conſiderable quantity; but the following analyſis has ſhewn, that it does not contain any portion of iron.

A.

1) *Two hundred* grains of this ore of manganeſe in pure cryſtals were pulverized, covered in a matraſs with *muriatic acid*, and, without heating, ſet by for ſome hours. The acid quietly diſſolved the ore, and afforded with it a very ſaturate deep brown-red fluid. If ſuch a ſolution, prepared in

the cold, be diluted with water, the oxyd of manganeſe ſeparates in looſe brown flocks, and in moſt caſes leaves the ſupernatant fluid entirely deprived of colour. But the above brown ſolution was digeſted upon a coal-fire; during which the materials frothed much, and oxygenated muriatic gas was diſengaged. When the gas had ceaſed to come over, and the ſolution been diluted with water, it exhibited a faint reddiſh colour; and the whole was found diſſolved, with the exception of ſome light black flocks, which ſeemed to be graphite; but could not be examined, their quantity being too ſmall.

2) I divided the ſolution into two equal parts, and examined *one half* of it, beſides other trials, with the following reagents,

a) On the addition of ſome drops of *concentrated ſulphuric acid*, it continued clear and unchanged.

b) *Pruſſian alkali* produced a precipitate of the colour of peach-flower.

c) The *carbonated alkalis* threw down a white precipitate, which alſo preſerved its whiteneſs on expoſure to the air.

d) On the contrary, the precipitate obtained by means of *cauſtic alkalis*, paſſed to the brown.

e) Water impregnated with *ſulphurated hydrogen gas*, produced no change or turbidneſs.

3) The *other half* of the ſolution I neutralized with *carbonate of pot-aſh*, until a weak turbidity began to appear; upon which I brought it to the ſtate of ebullition. But

only a few, hardly perceivable brown flocks ſeparated, which collected on the filter, reſembled minute particles of duſt. I then precipitated the filtered fluid, at a temperature of 212° Far. with carbonated pot-aſh. The white carbonated oxyd of manganeſe, which I thus obtained, amounted to 133 grains, when edulcorated and dried in a gentle heat. Upon ſtrong ignition in a covered crucible, it returned from the fire of a cheſnut-brown colour, and weighed 88½ grains.

By pouring upon this laſt ſtrong *nitric acid*, adding a little ſugar, and heating, I procured a complete and colourleſs ſolution. This nitric ſolution being poured into a retort and diſtilled to dryneſs, left the manganeſe in the ſtate of *perfect* oxydation, and in the form of a ſolid, lead-grey maſs of a metallic luſtre behind.

B.

a) *Two hundred* grains of the ore, in groſsly broken cryſtals, were heated to a thorough redneſs in a ſmall coated glaſs retort, connected with the pneumatic apparatus. The gas collected amounted only to 9 grains, upon deducting the common air of the apparatus; but ſhewed by the lively combuſtion of an iron wire confined in it, that it was pure *oxygen gas*.

b) In the ſmall intermediate hollow glaſs-ſphere of the apparatus, a conſiderable quantity of moiſture has condenſed, which weighed 14 grains, and was pure *water*.

c) The manganeſe, having ſuſtained that ignition, weighed 181 grains. The external luſtre of the cryſtals was very diminiſhed, and their grey colour turned blackiſh.

undred parts of this ore have, conſequently, been decompoſed into;

Black oxyd of manganeſe, combined with the maximum of oxygen which it is capable of retaining in a *fixed ſtate*, while acted on fire	90.50
r	7.
Oxygen gas 4½ cubic inches, or by ight	2.25
	99.75

The manganeſian ore from Ilefeld, therefore, contains only a ſmall quantity of ſuperabundant oxygen; and is, for this reaſon, very little proper for the purpoſe of preparing oxygen gas, or oxygenated muriatic acid.

Concerning the obtained water, the quantity of which amounting to 7 *per cent.* was conſtantly the ſame on repeating the experiments; it is too great to admit of being conſidered as merely a *hygroſcopic* moiſture (imbibed from the atmoſphere). On this ground it muſt unqueſtionably be taken for the water of cryſtallization in this ore of manganeſe.

II.

Ore of Manganeſe from Moravia.

The *Moravian* ore of *manganeſe* is ſteel-grey on the freſh fracture, poſſeſſes a metallic luſtre, and conſiſts of ſhort, partly faſciculated, partly concentrically ſtriated and diverging needles, accumulated into a compact maſs.

One

A.

One hundred grains of it entirely diſſolved, without leaving any reſidue, in the muriatic acid affuſed upon them, and aſſiſted by a digeſting heat; at the ſame time, that oxygenated muriatic acid gas was extricated. The ſolution, when mixed with water, was deſtitute of all colour, and proved, upon examination, to contain no particle of iron. I treated it with carbonate of pot-aſh in a boiling heat. The manganeſian oxyd thrown down, weighed 136 grains; but on being reduced by ignition in a covered crucible, to the ſtate of the *brown oxyd of manganeſe*, it weighed only 87 grains.

B.

Two *hundred grains* of this Moravian manganeſe were heated to redneſs, in a ſmall coated glaſs-retort connected with the pneumatic apparatus. The neck of the retort was found lined with only a ſlight quantity of moiſture in the form of dew-drops, which might weigh about 1 grain. The quantity of *oxygen gas*, which rapidly came over, amounted to 41 grains; and was of a great purity, as the experiments of combuſtion made with it proved. The remaining ore of manganeſe loſt 22 grains of weight.

Hence by this treatment the native mixture of this ore has been decompoſed into:

Black oxyd of manganeſe, combined with the maximum of oxygen with which it can continue united in the fire	89.
Water	0. 50
Oxygen gas 20½ cubic inches, or by weight	10. 25
	99. 75

CXIII.

CHEMICAL EXAMINATION

OF THE

ent

EARTHY BLACK ORE

(Oxyd)

OF MANGANESE.

THE *earthy black ore* (oxyd) *of manganeſe*, which has been the ſubject of the preſent inquiry, has been collected a few years ago in the gallery *Cron-Calenberg*, belonging to the mine *Dorothea*, on the *Harz*. It has been found there as a *guhr*, that is, in the form of a muddy, greaſy ſubſtance, iſſuing from the clefts of the rocks; but on expoſure to air it ſoon dried up to a very ſubtle, black powder.

A.

a) *One hundred* grains of it, firſt freed by means of a hair-ſieve from the admixed groſſer fragments of ſtone, were introduced into a coated glaſs-retort connected with the gas-apparatus, and ignited. The gas extricated in this proceſs amounted to $5\frac{1}{2}$ cubic inches, and was found to be *carbonic acid gas*.

b) In

) In the intermediate ſpherical veſſel 17½ grains of
er had collected, giving a ſomewhat metallic taſte, ind-
cating a ſlight trace of ammoniac.

) The ignited reſidue, in which, in other reſpects, no
nge was obſervable, weighed 7[illegible] grains.

B.

) *Hundred* grains readily diſſolved in the muriatic acid,
was poured upon in the cold. They afforded with it
ll dark-brown fluid; but this, after ſome digeſtion, with
aſſiſtance of heat, aſſumed a bright wine-yellow colour.
epoſited a blackiſh-grey ſediment, which, upon moderate
ition in a covered crucible, weighed 9 grains. By ſub-
uent ignition in an open teſt, its colour changed into a
yiſh-white, and its weight diminiſhed about 1 grain.
erefore that blackiſh colour had ariſen from a portion
carbon (radical); as, probably, in the preceding ex-
iment, the ſame principle has contributed to the genera-

d) From the remaining fluid, which now was colourleſs, a *white oxyd of manganeſe* was precipitated by means of carbonated pot-aſh and the aſſiſtance of boiling heat. This oxyd being brought to the ſtate of the brown oxyd, by igniting it in a covered crucible, weighed 68 grains.

Therefore, the obtained conſtituent parts were:

Brown oxyd of manganeſe	68
Oxyd of iron.	6. 50
Carbon (radical)	1.
Barytes	1.
Silex	8.
Water	17. 50
	102

The increaſe of weight, in this ſum, probably depends on this circumſtance, that the ignited oxyd of manganeſe has afterwards combined with a greater proportion of oxygen, than is contained in the natural compoſition of the crude foſſil.

It is of thoſe *manganeſian guhrs* *, that Nature makes uſe of as a colouring principle in the delineations of *dendrites*, which often are amazingly beautiful, upon compact limeſtones, bituminous marlites *(Mergel-ſchiefer)*, ſome varie-

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* The ſenſe of the German expreſſion *Guhr*, has been explained at the beginning of this Eſſay. The ſame word is alſo ſometimes kept by, after the fluid has left the ſolid ſubſtance previouſly diffuſed in it; for inſtance, in the *pulverulent calcareous earth*, found on calcareous mountains of a conſiderable height, as ſome Alps in Swiſſerland, and which alſo has been called, *agaric mineral, lac lunæ*.—Tranſl.

CXIV.

CHEMICAL EXAMINATION

OF THE

ASPHALTUM FROM ALBANIA.

THAT variety of *Aſphaltum*, or *mineral pitch*, which occurs in mighty ſtrata at *Avlona*, in *Albania*, is greyiſh-black, breaks maſſive, is opake, both externally and internally, of a moderate luſtre, of the greaſy kind, but is rendered dull by the ſtreak; its fracture is imperfectly flat-conchoidal, the fragments ſharp. It feels ſomewhat fattiſh, is ſoft, mild, and light. I found its ſpecific gravity equal to, 1. 205.

It burns with a ſtrong and lively flame, and is conſidered as the principal ingredient in the *grecian fire*, ſo much renowned in former times.

A.

Aſphaltum is ſoluble only in *oils*, and various ſpecies of *Naptha* chemically prepared. *Rectified petroleum* is, among others, a good menſtruum for it. *One* part of aſphaltum, covered in the cold with *five* parts of rectified petroleum, gave, after 24 hours, a ſaturated ſolution of a dark black-brown colour, which upon evaporation in a low heat, left the diſſolved portion, in the form of a black-brown, ſplendent varniſh.

In a ſimilar manner a ſolution of aſphaltum was effected in pure *ſulphuric ether*. The ſolution preſented a pale brown-red colour, and left the bitumen, after the ether had exhaled, in the ſtate of a brown-red, thick-fluid extract. Pure alkohol, digeſted with this extract, was incapable of re-diſſolving it.

Acids are of no ſervice towards a ſolution of aſphaltum; and as little alſo can this bituminous ſubſtance be altered by boiling it in a concentrated *cauſtic* alkaline lye.

B.

Aſphaltum, by decompoſition in the *dry* way, gave the following reſults.

1. One hundred grains were introduced into a ſmall retort of glaſs, and after this had been connected with the pneumatic-apparatus, the diſtillation was carried on, till the veſſel, with its contents, was throughout red-hot. The gas obtained, which at the end of the operation came over clear, without any vapour or ſubſtance among the veſſels, meaſured [illegible] cubic inches; and conſiſted of carbonated hydrogen gas, in which no diſtinct trace of carbonic acid gas was perceptible.

2. The matters diſtilled over were:

a. [illegible] grains of a light-brown, thin-fluid, bituminous oil.

[illegible] grains

2) 6 grains of *water*, which gave ſlight indications of *ammoniac*.

c) The reſidue, which coated the bottom of the retort in the form of a little cohering cruſt, was of an iron-grey, and poſſeſſed of a metallic luſtre. It weighed 46 grains. Being burned on a teſt, it left 16 grains of brown aſhes. The radical *carbon*, which had been conſumed, amounted, therefore to 30 grains.

d) Thoſe *aſhes* were mixed with a quadruple weight of carbonated pot-aſh, and ignited. The melted maſs was ſaturated in exceſs with *muriatic acid*, then evaporated to a dry ſalt, and again diffuſed in water; after which I ſeparated the ſiliceous earth by filtration. It weighed 7½ grains when ignited. The ſolution now freed from this ingredient, was ſuperſaturated with a *cauſtic* alkaline lye, digeſted and filtered. The lye was found to have taken up from it ſome *aluminous earth*, which being precipitated and ignited, gave 4½ grains. The reſiduum which has eluded the action of the cauſtic lixivium, was firſt diſſolved in *muriatic*, and then combined with ſulphuric acid, which produced ſulphate of lime, containing ¼ of a grain of *pure calcareous earth*. I now mixed and boiled the ſolution with carbonated pot-aſh, until a turbidneſs began to appear. Here an *oxyd of iron* ſeparated, weighing 1¼ grains after red-heat. What remained of the fluid, was combined with more carbonate of pot-aſh in a heat of ebullition; and on ſo doing, a ſlight portion of white *oxyd of mangane∫e* fell down, which in a red-heat, turned brown, and weighed ½ grain.

Therefore, *one hundred* grains of this *asphaltum* f *Avlona*, have given partly as *products*, partly as *educts*.

36 cubic inches of *Carbonated hydrogen gas*.
32 grains — *Bituminous oil*.
6 — — Feeble ammoniated *water*.
30 — — Radical *Carbon*.
7.50 — — *Silex*.
4.50 — — *Alumine*.
0.75 — — *Lime*.
1.25 — — *Oxyd of iron*.
0.50 — — *Oxyd of manganese*.

CXV

CXV.

CHEMICAL EXAMINATION

OF THE

EARTHY BROWN-COAL.

(*Earthy* or ſcaly *carbonated Wood,* by *Kirwan.*)

THE *earthy brown-coal*, alſo called *bituminous wood-earth*, occurs principally in the county of *Mansfeld*, and on the *Saal*; ſometimes in conſiderably thick ſtrata, and in moſt caſes only at a little depth under the vegetable earth. It has a blackiſh-brown colour, is dull, and of an earthy fracture, ſtains a little, is ſoft, eaſily pulverizable, and crumbles into duſt in the air.

To the inhabitants of thoſe diſtricts it ſerves as a very uſeful combuſtible. To prepare it for that uſe, it is kneaded with water into a ſomewhat tenaceous maſs, and ſhaped in wooden moulds in the manner of bricks. In this form, previouſly dried in the air, it is uſed as a fuel.

Its external appearance and chemical relations ſhew, that originally it conſtituted the *fibrous conſtituent part* of a mighty maſs of wood accumulated by floods; which, though changed by putrefaction in its eſſential compoſition, yet has not been entirely deſtroyed.

The

The brown-coal, ſubjected to the following inveſtigation, comes from *Schraplau*, an eſtate of the Prince Ferdinand of Pruſſia.

A.

Two hundred grains of it were ſubmitted to a red-heat in a glaſs retort, connected with the pneumatic mercurial apparatus. The products of this decompoſition, by fire, were:

1) The gas obtained after the common air had been expelled from the veſſels, amounted to 135 cubic inches. Of theſe lime-water has abſorbed 17 cubic inches, being *carbonic acid gas*. The remaining 118 cubic inches conſiſted of *carbonated hydrogen gas*.

2. The liquor diſtilled over conſiſted of:

a) 24 grains of an acidulous water. Since the decoction of the crude foſſil with water contains no acid; that obtained in this diſtillation muſt be conſidered as newly generated, and probably as *pyro-ligneous acid*[*].

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[*] The author ſeems to have purpoſely preſerved here the common terminology: for, it cannot have eſcaped his memory that the celebrated *Gren* had already, in the year 1794, aſſerted the identity of the *pyro-ligneous* with the *acetic* acid. A doctrine which Gren has repeated in his *Principles of Modern Chemiſtry*, 8vo. London, 1800. Vol. I. pag. 335; and which has been afterwards confirmed by the experiments of *Fourcroy* and *Vauquelin*, related in *Nicholſon's Journal*. Edit. 4to. Vol. V. pag. 91.

b) 60 grains

b) 60 grains of a light-brown coagulated *oil*, which ſhewed no reſemblance to any bituminous oil, but emitted only a weak empyreumatic ſmell.

3) The charred reſidue in the retort weighed 77½ grains. When ignited upon a teſt, there remained 37 grains of light-browniſh aſhes mixed with grains of ſand. The conſumed carbon, therefore, had amounted to 40½ grains.

4). *a)* The aſhes were elixiviated with water. The fluid ſeparated by filtration tinged reddened litmus-paper with a faint blue. Upon evaporation, it left *ſulphate of lime*, weighing 5 grains after ignition. It was a ſlight portion of uncombined calcareous earth preſent in the liquor, which had reproduced the blue colour of the reddened litmus-paper.

b) Upon the elixiviated aſhes, *nitro-muriatic acid* was poured. The inſoluble *ſandy reſidue* weighed 23 grains.

c) *Cauſtic* ammoniac threw down from the ſolution a light-brown precipitate, which by means of a cauſtic lixivium, was ſeparated into 2 grains of *oxyded iron*, and 1 grain of *aluminous earth*.

d) The remaining part of the ſolution yielded, on the addition of carbonate pot-aſh, *calcareous earth* of 4 grains weight upon ignition.

B.

Spirit of wine extracts, by digeſtion, from the earthy brown-coal, a brown-red tincture, which, on evaporation, leaves a deep brown-red extract; the taſte of which is moderately bitter without being diſagreeable, and not ill reſembles the taſte of the extract from an inferior ſort of the Peruvian bark. In water it re-diſſolved but imperfectly, and gave with it a turbid mixture.

C.

Four ounces of this earthy brown-coal yielded on three repeated boilings with water, a clear, brown-red decoctum, which tried as a re-agent, ſhewed neither the relations of an alkali, nor thoſe of an acid. By evaporation in a gentle warmth, it afforded a dry, pulverizable extract, of a nut-brown colour, of 145 grains weight, and of a ſimilar mild, bitter taſte as the preceding (B). Upon the affuſion of a little water it readily diſſolved, yielding a limpid dark-brown fluid; at the ſame time, that it depoſited a yellowiſh-white ſediment, which in the dry ſtate weighed 39 grains, and was ſulphated lime.

With this re-diſſolved extract I tried ſeveral various combinations.

a) No turbidneſs nor change of colour enſued on combining it with the ſolutions of animal gluten, alkaline ſalts, alum, nitrated lime, ſulphate of copper, and recently cryſtalized ſulphate of iron.

b) The ſolution of this extract was decompoſed by barytic water, the ſolutions of nitrated barytes, muriate of zinc, nitrate of ſilver and of mercury, acetate of lead, muriated oxyd of iron, &c. On the addition of theſe, fine flocculent precipitates were formed of a light-brown wood-colour, and the ſupernatant liquor, in moſt caſes, appeared quite colourleſs.

If

D.

If the earthy brown-coal be digeſted with a moderately ſtrong *cauſtic lye*, it ſeems that almoſt the whole of its combuſtible portion is diſſolved into, as it were, a fluid black coal. When diluted with from 12 to 16 parts of water, and filtered, the fluid ſtill preſerves its ſaturated deep black-brown colour. By ſaturation with ſulphuric or nitric acid, the black-brown colour becomes brightened into a brown-red; and on the application of heat, a brown ſlimy precipitate depoſites; which, collected on the filtrum and edulcorated, dries up in a warm temperature to coal-black, ſtrongly ſhining lumps, which, on being burned upon a teſt, leave yellowiſh aſhes behind.

E.

Two ounces of oil, that had been procured by diſtillation from a larger quantity of this brown-coal, were put into a retort in order to be rectified, and 1½ ounce was diſtilled over in a moderate ſand-heat. The reſidue preſented a blackiſh-grey colour, and aſſumed, on cooling, a waxy conſiſtence. But the diſtilled portion had a honey-yellow tinge, and congealed in a cryſtalline, foliated form. When a little of it was put upon filtering paper, it imbibed the thinner portion of the oil, but that of a thicker conſiſtence remained on the paper in light-browniſh, reſplendent, ſeparable lamiæ, or ſcales.

If the oil be heated upon coal-fire until the greateſt part of the aqueous moiſture is evaporated, it aſſumes, upon cooling, the conſiſtence of a white cerate (*ceratum album*). In this ſtate it very much reſembles the *Maltha*, or *Sea-wax* from *Siberia*.

Spirit of wine diſſolves the oil educed from the earthy brown-coal, by digeſtion, clearly and pretty copiouſly. The ſolution, as it cools, coagulates to a gelatinous conſiſtence. The mentioned Maltha is affected in the ſame manner by ſpirit of wine *.

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* This *Sea-wax*, or *Maltha*, is procured from the *Baikal Lake*, on the ſhores near *Barguſin*. The claſſification of this product of Nature with the bituminous ſubſtances I think improper, for various reaſons. May it not be the product of a diſtillation, performed by Nature,—from a ſimilar ſpecies of brown-coal?—As the *earthy brown-coal*, which has been the ſubject of the preceding inquiry, cannot be ſubordinated to the bituminous foſſils, neither in a chemical, nor in a geognoſtic view, its former denomination of *bituminous wood-earth*, is no longer admiſſible.

CXVI.

CHEMICAL EXAMINATION OF THE *HUNGARIAN PEARL-STONE.*

THE mountainous region of *Telkebanya*, in *Upper Hungary*, excels by its various, and often very beautiful ſpecies of ſtones; ſeveral of which, for inſtance, the noble opal, are its peculiar property. To theſe alſo belongs that ſtone, which, for the firſt time, has been brought into public notic. and deſcribed by Mr. *Fichtel*[*], under the name *Volcanic Zeolite*, as that whole range of mountains was conſidered by him as maſſes ejected by fire. But ſince experienced Mineralogiſts have examined thoſe mountains, and proved that aſſertion to be deſtitute of truth; the above denomination, founded on *Fichtel's* hypotheſis, has alſo been diſcarded as inadmiſſible. Among others, principally Mr. *Eſmark*, in his inſtructive *deſcription of a mineralogical voyage through Hungary*[†], has given a full account of that mountainous diſtrict, together with a characteriſtic deſcription of the foſſils there occurring, and of this in particular; to which I refer the reader. The ſame foſſil has alſo by ſome been conſidered as belonging to pitch-ſtone, and called *Zeolitic pitch-ſtone*; while others took it for a ſpecies of Zeolite in a ſtate of tranſition into Obſidian.

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[*] *Fichtel*, mineralogiſche Bemerkungen van den *Karpathen*, Wienn. 1791. 1 Theil. pag. 365. 2 Theil. pag. 648.

[†] See Neues bergmänniſches Journal, Vol. ii. pag. 62. ſeq.

But at preſent Mr. *Werner* has aſſigned to it a peculiar place, in the ſyſtematical arrangement, on the ſide of pitch-ſtone; and from the granular ſhape of the ſeparated pieces, he called it *Pearl-ſtone*.

The *Pearl-ſtone*, examined by the analyſis I am going to relate, has a duſky aſh-grey colour, traverſed in ſome places, in the manner of ribbons, by yellowiſh-grey ſtripes. It is found between *Kereſtur* and *Tokay*, in ſtrata alternating with thoſe of argillaceous porphyry.

Its ſpecific gravity I found to be, 2. 340.

I.

a) Before the blow-pipe, upon charcoal, it intumeſces, in the manner of zeolite, in a frothy form, but fuſes not.

b) A piece of pearl-ſtone was expoſed, for two hours, to a moderate red-heat. It returned from the fire without any alteration in its ſhape; the colour, however, had paſſed into the reddiſh-brown; and the ſtone ſuffered a diminution of weight of $4\frac{1}{2}$ *per cent.*

c) In the fire of the porcelain furnace, ſpecimens of this foſſil were perfectly *vitrified* in the *charcoal crucible*, as well as in that of *clay* *.

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* See Eſſay I. of this Work, pag. 34.

II.

a) Upon one *hundred* grains of pulverized pearl-ſtone, in a ſilver-crucible, I poured a cauſtic lye, holding 300 grains of ſoda in ſolution; and after having inſpiſſated the whole, I ignited it ſtrongly during half an hour. The ignited maſs ſhewed a greeniſh-white colour. I ſoftened it up with water, ſaturated it with *muriatic acid* added in exceſs, and evaporated the mixture to dryneſs in a ſand-bath. When re-diſſolved in water, I filtered off the *ſiliceous earth*, which edulcorated, dried and ignited, weighed 74¾ grains.

b) The muriatic ſolution was combined to ſuperſaturation with *cauſtic* ammoniac. The precipitate produced was collected on the filter, waſhed, and while yet moiſt, introduced into a *cauſtic lye*, in which, aſſiſted by heat, it ſoon diſſolved; leaving a brown reſidue behind. After this reſidue had been ſeparated by filtration, I poured into the liquor muriatic acid, until the new precipitate, which thence reſulted, was again clearly diſſolved. Which done, it was afreſh precipitated with *carbonate* of ammoniac, then edulcorated and ignited. It weighed 12½ grains, and proved, on farther examination, to be aluminous earth. On its re-diſſolution in ſulphuric acid, I obtained *ſiliceous earth*, weighing ½ grain when ignited. So that, deducting this laſt, there remain 12 grains for the *aluminous earth* ingredient in the foſſil.

c) The brown reſidue left by the cauſtic lixivium was treated with *muriatic acid*, and the portion of iron which it contained was precipitated by *cauſtic* ammoniac. The obtained *oxyd of iron* being ignited, weighed 1.60 grain.

The remaining colourleſs fluid yielded, by precipitation with carbonated ammoniac, a ſmall quantity of calcareous earth.

d) The water, with which the precipitate obtained by cauſtic ammoniac *b)* had been edulcorated, was combined with carbonate of pot-aſh, and evaporated by means of heat. On re-diſſolving this ſaline maſs, another ſlight quantity of carbonated lime appeared, which, together with that obtained in the experiment *c)* ſhewed the portion of *pure calcareous earth* to be ½ grain.

III.

a) *One hundred* grains of pearl-ſtone were ground fine, well mixed with 400 grains of cryſtallized *nitrate of barytes*, and ignited in a porcelain-veſſel by a fire gradually raiſed until the complete decompoſition of the nitric acid. After cooling, the maſs was pulverized, diluted with water, and ſuperſaturated with muriatic acid. I then evaporated the ſolution in a ſand-heat, adding by degrees ſulphuric acid, till the muriatic was wholly driven out. Upon this I diffuſed the inſpiſſated maſs in a ſufficient quantity of water, and ſeparated, by filtration, the ſiliceous earth which it contained, together with the generated ſulphate of barytes. The ſulphuric fluid was, in the next inſtance, neutralized with carbonate of ammoniac, filtered off from the iron-ſhot aluminous earth which the alkali had thrown down, and laſtly, evaporated in a ſand-heat to a dry ſalt.

b) This ſulphate of ammoniac was gradually expelled in a platina crucible, by means of a moderate, well regulated heat. A fixed ſalt of 8 grains weight remained, and proved to be ſulphate of pot-aſh. Thus alſo the preſence of *pot-aſh* in this foſſil, as a conſtituent part, has been diſcovered

by

by this management, and its proportion found to be 4½ in one hundred.

One hundred parts, therefore of this *Hungarian Pearl-ſtone* contain:

Silex	II. *a*)	74. 75	75. 25
	— *b*)	0. 50	
Alumine	— *b*)		12.
Oxyd of iron	— *c*)		1. 60
Lime	— *d*)		0. 50
Pot-aſh	III. *b*)		4. 50
Water	I. *b*)		4. 50
			98. 35

THE END.

ERRATA.

Page	Line				
7	3	—	*ary*	read	*dry.*
8	9	—	6.185		6.115.
14	25	—	*a half*		*a fourth.*
17	2	—	effuſed		affuſed.
29	22	—	few grains		few minute particles.
—	30	—	gas		hydrogen.
31	8	—	ore		precipitate.
55	6	—	lixivium it,		lixivium, it.
75	1	—	their		there.
78	22	—	inth is		in this.
80	18	—	nafforded and		and afforded a.
150	21	—	lead, when		lead. When.
169	9	—	ſoda.		ſoda, weighing 40 grai
174	22	—	adding [illegible]		*dele* of.
178	13	—	weighed grain		weighed ½ grain.
230	5	—	*(Taſel-ſpath)*		*(Tafel-ſpath).*
238	5	—	*grained*		*granular.*
245	19	—	9 grains		9 cubic inches.
247	18	—	41 grains		41 cubic inches

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